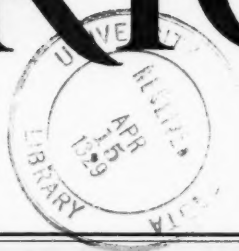


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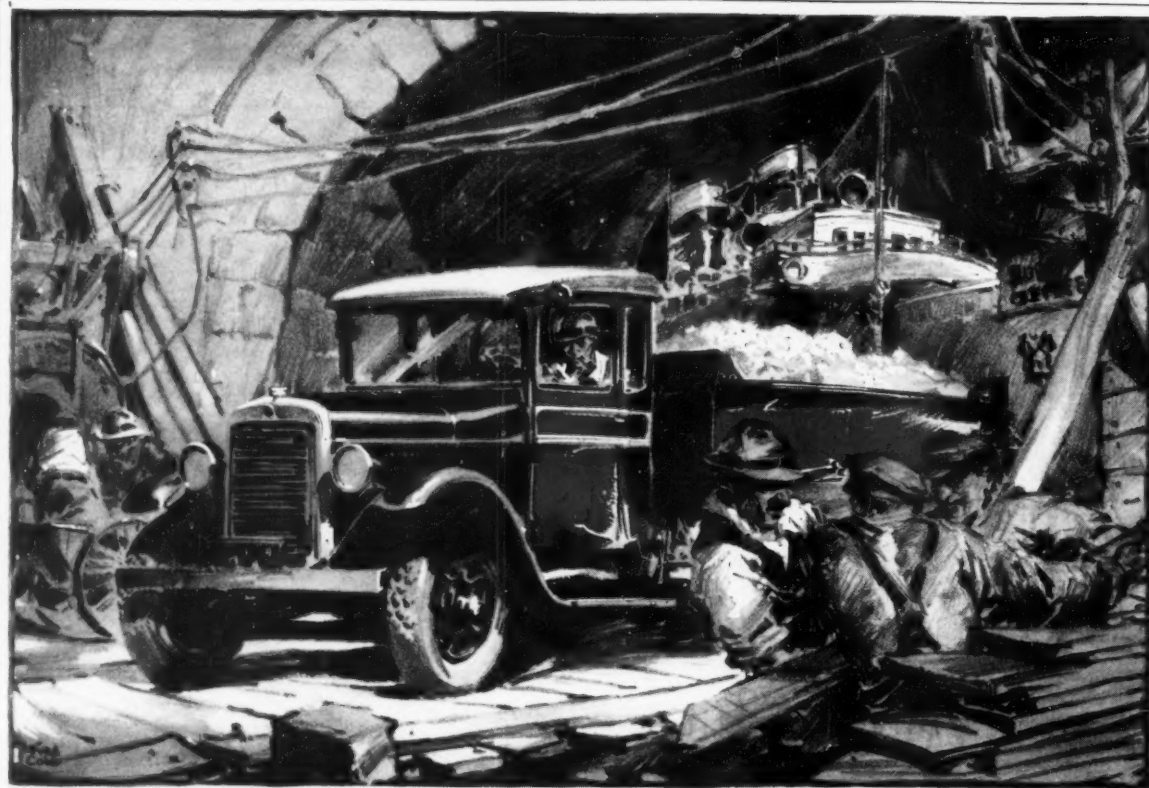


THE GUNS AGAINST THE AIRPLANES
THE NEW OUTLOOK IN PHYSICS
HAVE PLANTS A HEART BEAT?

DODGE BROTHERS TRUCKS



CHRYSLER MOTORS PRODUCT



**For power and speed,
for low costs and high earnings**
/ / / Dodge Trucks

YOU find Dodge Trucks at work on hauling or delivery jobs everywhere They are fast, powerful, rugged, dependable—a safe choice where truck investment is checked closely against truck earnings.

Operating costs are extremely low; service and repair parts readily accessible—always and everywhere—bodies and chassis built in types and sizes to fit your every need.

Only great volume production enables us to build trucks so good at prices so low Shrewd, alert purchasers buy more than a million dollars' worth every week.

Inspect the complete line at your Dodge Brothers Dealer's. See the chassis size and body type that exactly fits your needs Put one of these tested money-makers to work for you.

Formerly Graham Brothers Trucks

The complete line of Trucks, Buses and Motor Coaches manufactured by Graham Brothers (subsidiary of Dodge Brothers) now take the name of Dodge Brothers

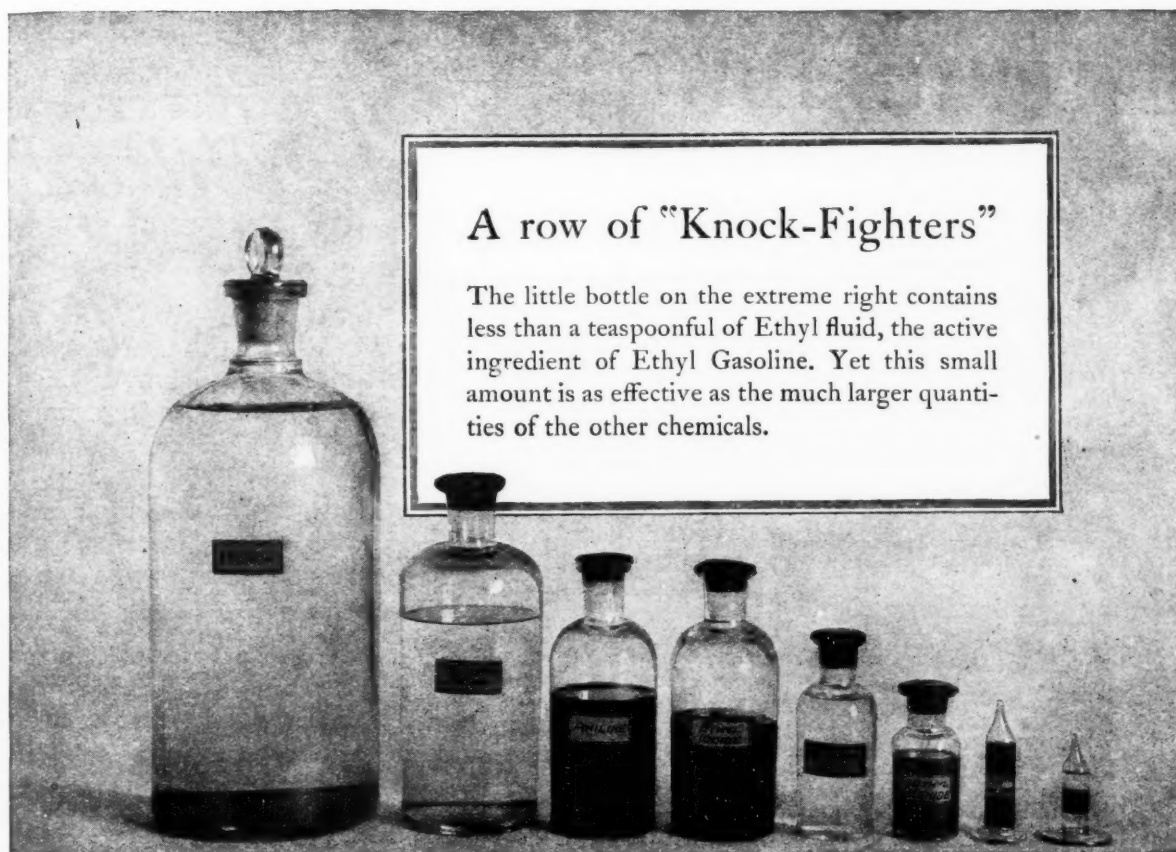
These Trucks, Buses and Motor Coaches, powered by Dodge Brothers engines and manufactured according to Dodge Brothers standards, are sold, as they always have been sold, by Dodge Brothers Dealers everywhere.

PRICES

MERCHANTS' EXPRESS—109" w. b.	\$ 545
COMMERCIAL TRUCK—120" w. b.	775
1-TON—130" wheelbase	995
1-TON—140" wheelbase	1065
1½-TON—150" wheelbase	1345
1½-TON—165" wheelbase	1415
2-TON—150" wheelbase	1515
2-TON—165" wheelbase	1585
3-TON—135" wheelbase	1745
3-TON—165" wheelbase	1775
3-TON—185" wheelbase	1845

Chassis f o b Detroit

SOLD BY DODGE BROTHERS DEALERS EVERYWHERE



© E. G. C. 1929

The Steps to High Compression Performance

THOUSANDS of chemical combinations were tested in the General Motors Research Laboratories to see whether they would eliminate the fuel "knock" in gasoline engines which was retarding the advancement of high compression engines. In the picture above are a few of the compounds that had anti-knock value. They illustrate the gradual progress toward more and more effective elimination of the "knock."

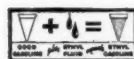
The little bottle on the right contains Ethyl fluid which is the active ingredient in Ethyl Gasoline. It is the most effective of them all. The amount in the little bottle is equivalent in anti-knock value to the amount of other chemicals contained in the larger bottles.

It is so effective that even a teaspoonful added to a gallon of gasoline makes Ethyl Gasoline—the standard high compression fuel which has made possible the new high compression cars. And it also brings out the maximum performance of which cars of average compression are capable.

Ride with Ethyl today.



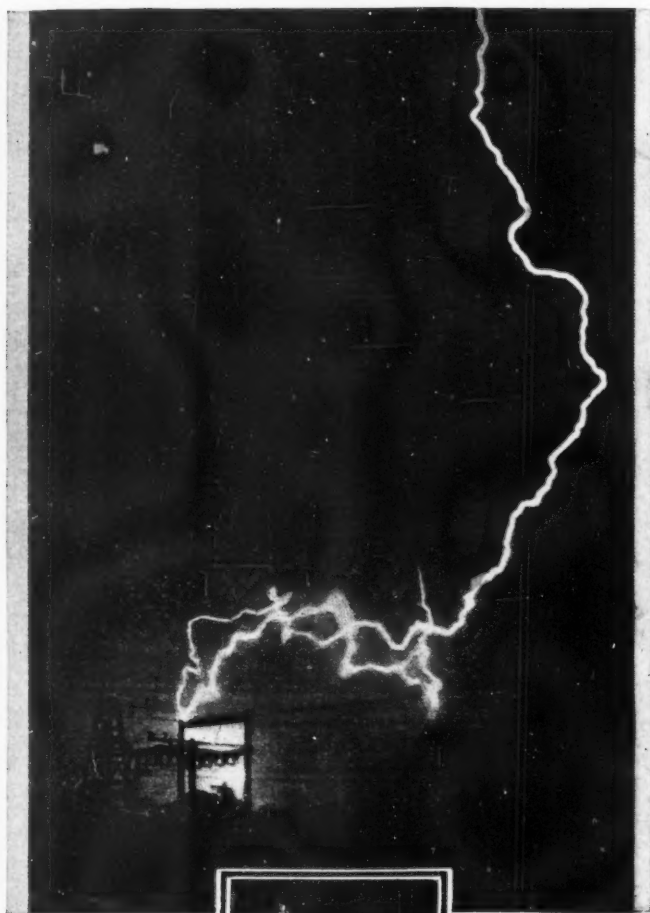
ETHYL



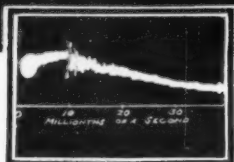
ETHYL GASOLINE CORPORATION
25 Broadway, New York City
56 Church Street, Toronto, Canada
36 Queen Anne's Gate, London, England

GASOLINE

Man's hand *upon the Lightning*



The cathode-ray oscillogram of the induced lightning surge.



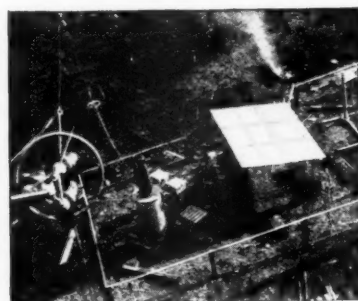
Back of every product bearing the G-E monogram, from an electric locomotive to the tiny motor that runs a sewing machine, is the basic scientific research for which the General Electric laboratories are famous. Both in the home and in industry this monogram carries the same assurance of electrical correctness and dependability.



NOT yet is the lightning tamed. But the hand of science reaches forth. Already a way has been found to make the lightning write its own record of this destructive force measured in millions of horsepower, which is still the greatest enemy of high-voltage transmission lines.

One such record is reproduced on this page. It was taken on the lines of the Pennsylvania Power and Light System by a cathode-ray oscillograph—a high-speed camera developed in the General Electric laboratories. The surge that was recorded measured 2,500,000 volts; the record showed that the lightning lasted 40 millionths of a second.

Before science can control natural forces it must first develop data and measurements. Ultimately out of this comes control. Fundamental research of this kind seldom brings immediate financial return. Its ultimate value, both to the electrical industry and to the public, is beyond price.



The special field laboratory which was used for the epoch-making experiment.

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GENERAL ELECTRIC

SCIENTIFIC AMERICAN

24 WEST 40th STREET

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Eighty-fifth Year

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Portable Nine-hole Golf Course	447	This month our artist, Howard V. Brown, has depicted a 105 millimeter anti-aircraft gun and mount, rear view, with the men of the operating crew at their stations. The man at the left is inserting a shell, nose first, into the machine which automatically times the fuse of the projectile according to data furnished by the range finder. The story of this and other anti-aircraft guns, and of various matériel for this rapidly advancing branch of our military defense, starts on page 424.	
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CARS THAT STAY YOUNG



Cars That Stay Young

MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	Steering Differ- ential
Auburn.....	All	.x.	.x.	.x.	.x.
Cadillac.....	All	.x.	.x.	.x.	.x.
Chrysler.....	De Soto Plymouth 65 & 75 Imperial	.x.	.x.	.x.	.x.
Cunningham.....	All	.x.	.x.	.x.	.x.
Dodge.....	All	.x.	.x.	.x.	.x.
Durant.....	40, 60, 66 70	.x.	.x.	.x.	.x.
Elcar.....	75	.x.	.x.	.x.	.x.
Ford.....	95, 96, 120	.x.	.x.	.x.	.x.
Franklin.....	All	.x.	.x.	.x.	.x.
Gardner.....	All	.x.	.x.	.x.	.x.
Graham-Paige.....	612 615	.x.	.x.	.x.	.x.
Hudson and Essex.....	621, 827, 837	.x.	.x.	.x.	.x.
Hupmobile.....	All	.x.	.x.	.x.	.x.
Jordan.....	Century 6 Century 8	.x.	.x.	.x.	.x.
Kissel.....	All	.x.	.x.	.x.	.x.
Kleiber.....	75 & 95 126	.x.	.x.	.x.	.x.
LaSalle.....	All	.x.	.x.	.x.	.x.
Lincoln.....	All	.x.	.x.	.x.	.x.
Locomobile.....	86 & 88	.x.	.x.	.x.	.x.
Marmion.....	68 78	.x.	.x.	.x.	.x.
McFarlan.....	Roosevelt	.x.	.x.	.x.	.x.
Moon.....	All	.x.	.x.	.x.	.x.
Nash.....	Sid 6	.x.	.x.	.x.	.x.
Peerless.....	All	.x.	.x.	.x.	.x.
Pierce-Arrow.....	All	.x.	.x.	.x.	.x.
Reo Flying Cloud.....	The Master The Mate	.x.	.x.	.x.	.x.
Roamer.....		.x.	.x.	.x.	.x.
Stearns-Knight.....	6-80 8-90	.x.	.x.	.x.	.x.
Studebaker and Erskine.....	All	.x.	.x.	.x.	.x.
Stutz.....	All	.x.	.x.	.x.	.x.
Willys-Knight and Whippet.....	All	.x.	.x.	.x.	.x.

WHEN motorists want to *know* how far cars will go . . . how long they will defy torque, thrust, speed and shock . . . how many care-free miles are assured . . . they refer to the list of Cars That Stay Young, noting the names of the prominent cars which are Timken-equipped and the points where Timken Bearings are used; and they let that be a deciding factor in buying.

For "Timken-Equipped" provides these exclusive preservers of car youth—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric steel.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN Tapered Roller BEARINGS

Looking Ahead With the Editor

A Revolution in Science

DR. HEYL, whom our readers have learned to look upon as a personal scientific mentor, has written an open letter on the partially discredited law of the conservation of matter. Scheduled for early publication, this letter explains why that law is now held to be only a close approximation to the truth and thus settles a vexing question that has puzzled many of us for years.

Ancient Vandals

EGYPTIAN despoilers of the tombs of kings wrought havoc by smashing art, architecture, et cetera, and thus have caused the archeologist much despair. The archeologist, however, pieces the bits together and is able to reconstruct the original. This interesting human sidelight on history is the subject of a forthcoming article on Egyptian vandalism 3400 years ago.

An Engineering Triumph

ACROSS the Hudson from Fort Washington on the New York side to Fort Lee on the New Jersey side, a great bridge is being built. The world's largest cables will swing between huge towers, that now stand in the river like sentinels, to form the world's longest span. A coming article describes progress of construction on this bridge, as accomplished to date of writing.

When Are You Asleep?

DO you sleep when your eyes close? Before they close? After? Do you ever really sleep with your eyes open while driving a car? Eye-acts, the facts about which vitally concern each of us, have been studied so little that we rejoiced when an article on the subject was submitted to us by an authority. This important document will be published in these pages soon.

Artificial Earthquakes

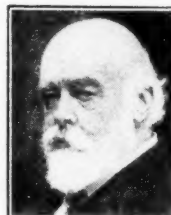
GEOPHYSICAL prospecting has come to be a valuable adjunct to the study of geology. By this process, scientists are learning vital facts about the sub-surface structure and composition of the earth. It may assist in locating minerals to supplement our rapidly diminishing supply. An article on the "seismic" method (using dynamite to percuss the earth) is coming.

Every Issue Fully Illustrated

The whole family will be interested in science if it is presented to them in the SCIENTIFIC AMERICAN manner. Keep them up-to-date in the affairs of the world by a yearly subscription. Only four dollars.

Among Our Contributors

Sir Oliver Lodge



SIR OLIVER needs no introduction to our readers—except they be of the younger generation who were not born when he was performing the experiments which made him world famous. He is a link between Hertz, who first discovered the principle of wireless, and Marconi, who perfected it. In his younger days he was a great physicist and is now a great popularizer of science. Further, he is a philosopher—which is more than a scientist—as his present article bears evidence.

Major G. M. Barnes

COMMISSIONED a Second Lieutenant in 1910, Major Barnes has since held many high positions in the Ordnance Department. In 1918, he headed a committee of engineers sent to France to design long-range guns; 1918 to 1922, had charge of development, design, and procurement of guns for our possessions; held the same position in respect to anti-aircraft artillery in the office of the Chief of Ordnance, 1923 to 1927; and now has charge of engineering and design section at the Watertown Arsenal.

Robert Stewart

AFTER graduation from the University of Utah and study at two other large universities, Professor Stewart was Professor of Chemistry at the University of Utah and Professor of Soil Fertility at the University of Illinois.



He is now Dean of the College of Agriculture at the University of Nevada. He is a frequent contributor of articles on farm economic subjects to many national magazines.

Leon Légrain

WHOLESALE murder was the order of the day when a king died in Ur 6000 years ago, according to Mr. Légrain, Curator of the Babylonian Section of the Museum of the University of Pennsylvania. In his article on page 404, which is replete with human interest, he describes the rich treasure which, with a dead "court," was entombed by the Sumerians with dead kings.

NEW AUTOMATIC PERSONAL SERVICE MACHINES THAT TELL PRIVATELY YOUR WEIGHT AND FORTUNE FOR A PENNY . . .

With pardonable pride we announce the crowning achievement of twenty years of concentration on the problem of making a penny actuated personal weighing scale of real accuracy, that would give the weight and fortune printed on a convenient ticket and embodying all features necessary to long uninterrupted accurate service to the public. It is the new International Ticket Scale, and truly, "Nothing of its kind is so fine."

Soon you will see it everywhere, in drug, cigar and other stores, in waiting rooms, and on platforms of transportation lines, in amusement parks, in theatres, and in those thousands of other places where you can conveniently use them.

ACCURATE WEIGHT OR YOUR MONEY BACK

The new International Ticket Scale embodies dozens of advanced improvements, probably the first of which is the fact that the scale is so constructed that if it cannot give your accurate weight printed on the ticket, it will return your penny.

INTERNATIONAL IS CARE-FREE

The sign "Out of order" will seldom appear on International Scales. Children jumping on their platforms will do them no harm, thanks to an ingenious shock absorbing device. Inclement weather cannot damage them. The supply of tickets will rarely be exhausted because the scale holds 10,000 tickets which may be added to at any time. But for those rare occasions when something does go wrong, a national service organization with service men in every town of importance in the United States, is ready to put the International Scale in perfect shape within twenty-four hours.

MANY PATENTED FEATURES

The essential improvements in the International Ticket Scale, including the ticket, "as distinctive in design as the scale itself," the printing mechanism, the self-inking ribbon, the balanced platform, the shock absorbers, to name just a few, are exclusive with International, and fully covered by strong patents.

NATIONAL ADVERTISING

The patronage which International Scales will win for themselves will be maintained by aggressive consumer advertising in a campaign embracing the major consumer advertising mediums.

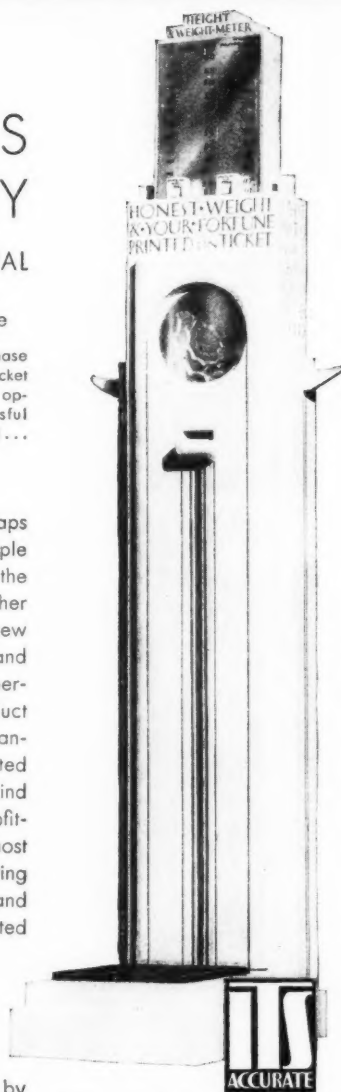
A BUSINESS OPPORTUNITY

THE NEW INTERNATIONAL TICKET SCALE

A private personal weighing service

Exclusive territorial franchise for the purchase and operation of chains of International Ticket Scales are now being negotiated. Your first opportunity to enter an outstandingly successful division of the Automatic Merchandising Field . . .

Did you weigh yourself today? Perhaps you did not, but literally millions of people did. Tons of pennies are dropped into the familiar penny scales in drug and other stores each day. • Now comes a new and better scale that prints the weight and fortune on a ticket. It gives a private personal weighing service. It is the product of twenty years of experience in the manufacture and operation of penny actuated scales. • Its slogan is "Nothing of its kind is so fine," and we might add, so profitable. In appearance the finest and most distinctive of scales. The scale and printing mechanisms are built on time-tried and approved principles refined, perfected and simplified for faster, more positive operation and greater accuracy. If you owned a chain of these scales working for you day and night, you would have a steady sure source of income, unaffected by economic changes, by poor business, or by other unfavorable factors. Each scale need be seen infrequently. You would have a business practically without overhead, with no credit problem, with no administration expense, and with the minimum of working personnel. • The first to place International Scales on location will reap an unusually rich harvest. Those now in a position financially to secure exclusive franchises for important cities, will look at the future with eyes that are unafraid. The earnings in this business, as

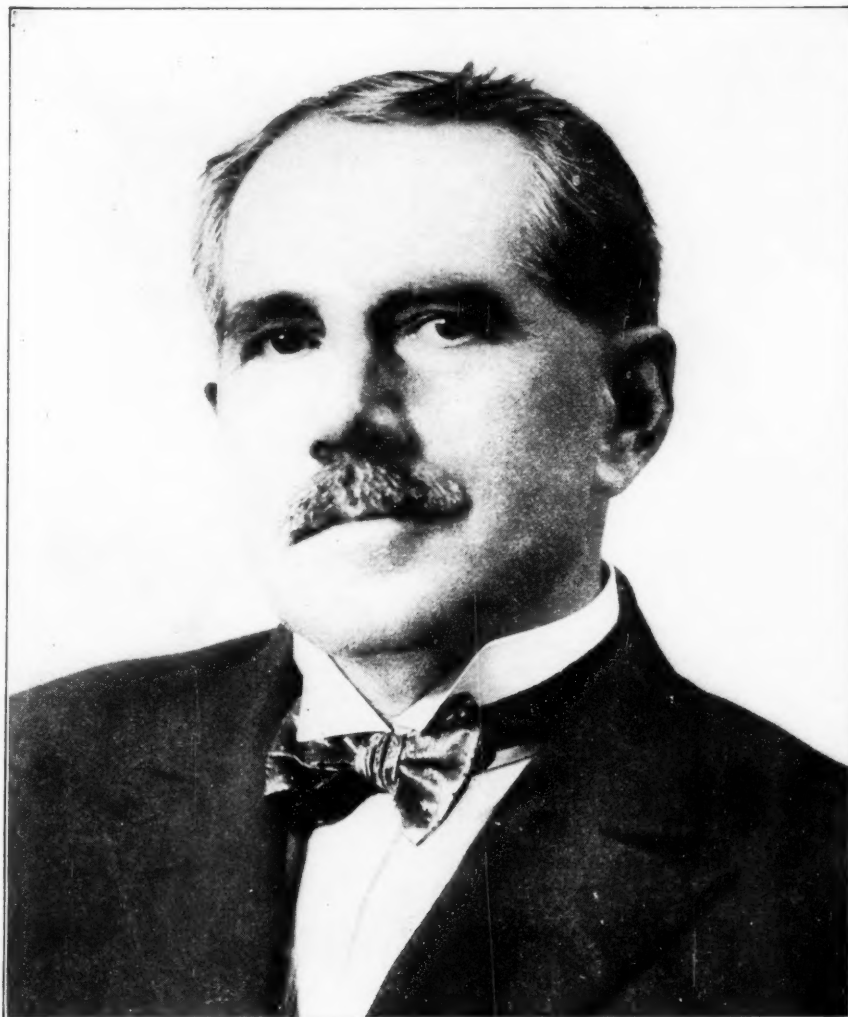


high as 47% annually on the investment, will also attract those with a few thousand dollars, who desire the maximum return from their investment, and who are willing to devote a small amount of their own time to their care. • Full details concerning all phases of the operation of chains of International Ticket Scales, are given in a booklet which we will be glad to send on request to any financially responsible person. Simply write Dept. 112; International Ticket Scale Corp., 17 East 45th St., New York, N. Y.

International

TICKET SCALE CORPORATION

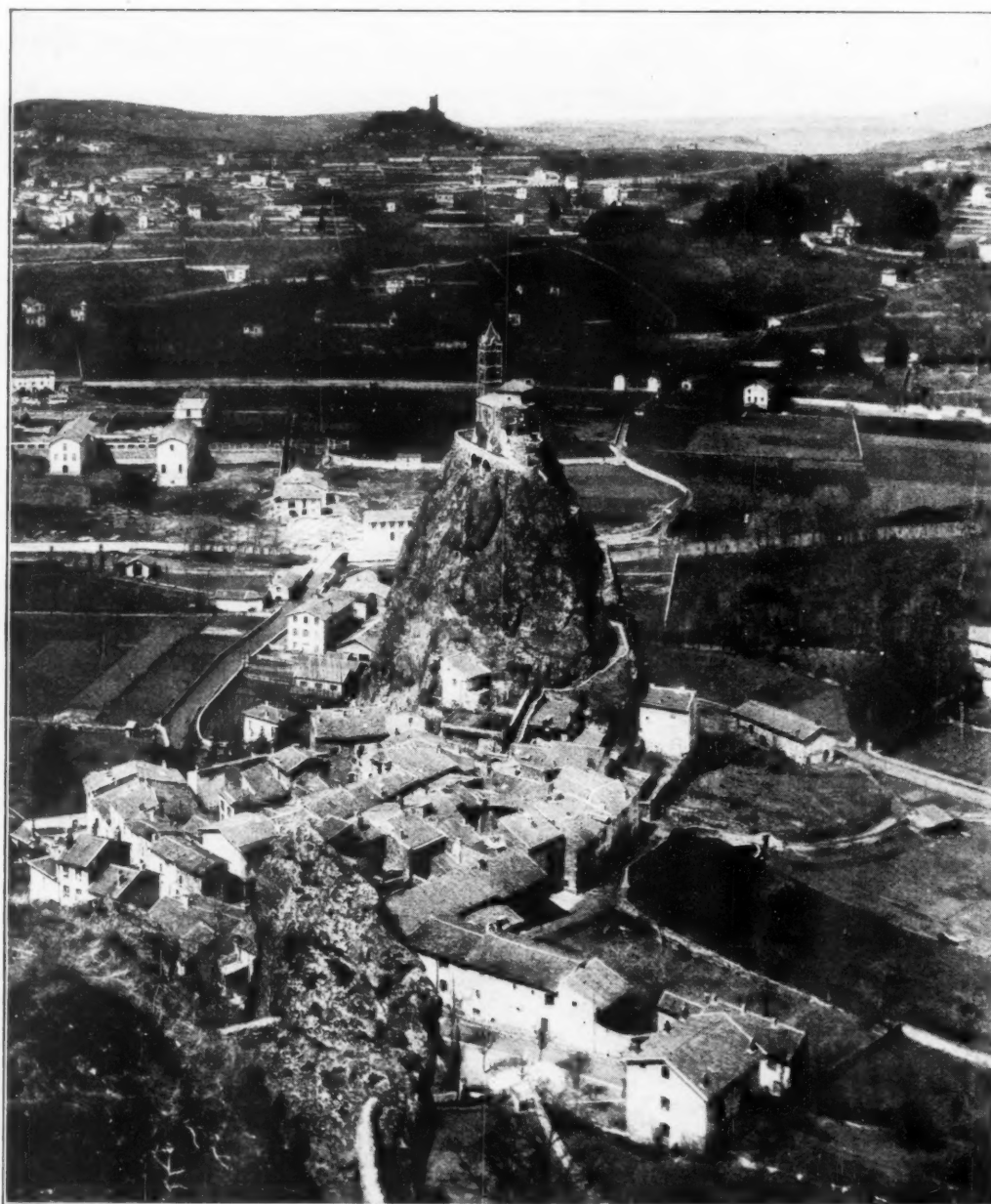
17 EAST FORTY-FIFTH STREET, NEW YORK, N. Y.



Charles F. Marvin

Professor Charles F. Marvin was educated as a mechanical engineer at Ohio State University. He has been Chief of the United States Weather Bureau since 1913, having been appointed upon the recommendation of the National Academy of Sciences, which was requested by President Wilson to submit names of men deemed eligible. At Colorado Springs, and Pike's Peak, early in his career, Professor Marvin conducted comparative observations of dewpoint temperatures and wet and dry bulb readings, which formed the basis of the tables for calculating the vapor content of the atmosphere. Later he was assigned to charge of the Instrument Division of the Weather Bureau, where he developed numerous forms of, and improve-

ments in, meteorological instruments, including anemometers, barometers, rain-gages, pyrheliometers, seismic apparatus, and devices for securing observations in the upper air. He is the author of numerous papers and articles appearing chiefly in the *Monthly Weather Review*, dealing with meteorological questions; including analysis of the question of alleged variability of solar radiation on which attempts at long-range weather prediction have been made. He has also carried on important studies in the simplification of the calendar, and was the first to formulate the effects on leap year rules in the construction of calendars, arising from the known slow, very gradual changes now taking place in the length of the year.



Ewing Galloway

Ancient Architecture in Modern France

NEAR one of the gates of the quaint old French city of Le Puy, or Le Puy en Velay, in the department of Haute-Loire, 90 miles south-west of Lyons, stands this curious little Church of St. Michel d'Aiguilhe, perched on the very top of an isolated rock of basalt. The church may be reached only by the laborious ascent of 271 steps, some of which, zigzagging up the precipitous face of the rock, are visible in the picture. This oddly situated church was

built not long before the year 1000, but its chancel, at the nearer end, is still older. To this church and to a larger one in the city of Le Puy itself, which is not included in the panorama, came during many medieval centuries thousands of pilgrims seeking paths of holiness. Beyond the church and tiny community, on the near horizon, is the old Castle of Polignac, now in partial ruins. The high, square 14th Century keep and a tower may be noted in the picture.

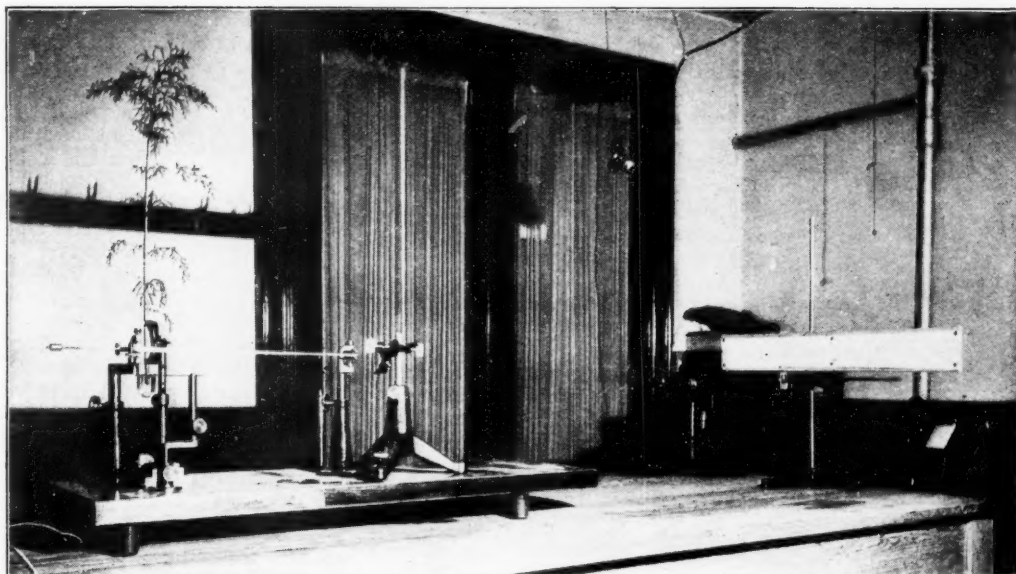


FIGURE 1: A PORTION OF THE LABORATORY, SHOWING THE SPHYGMOGRAPH

Have Plants a Heart Beat?

Using Great Refinement of Technique, an American Research Worker Repeats the Much Debated, Controversial Scientific Experiments of Sir Jagadis Bose, With Surprising Results

By G. A. PERSSON, M.D., M.S.

CONSIDERABLE controversy has already been occasioned in America by the publications of the well-known East Indian scientist, Sir Jagadis Bose; also by his many public lectures here. He not only claims to have proved by experiment that plants have "heart beats," but he sees evidences of life in metals and all other inorganic matter. These romantic claims, widely quoted in the American press, have reached an immense audience. We do not, however, know of a single American botanist of standing who accepts them. They have received some support in England, and a little in Europe. The experiments so lucidly described in this article lend no support to them.—*The Editor.*

SIR JAGADIS CHUNDER BOSE, famous Indian scientist educated at Cambridge University in England, founder of the Bose Institute at Calcutta, and author of a number of extremely interesting books describing his researches into the mysteries of plant life—researches which have brought him a knighthood and various honorary degrees—tells us in his latest volume, "Plant Autographs and their Revelations," that plants have a circulatory

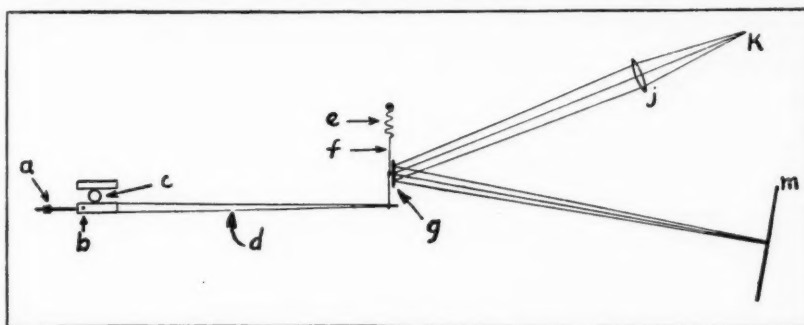
system essentially like our own, and backs this up by numerous diagrams showing the "heart beats" of various vegetables and flowers.

It must be confessed that this is a sufficiently remarkable discovery, but the present writer has, with all due respect, to report one even more astonishing. He has been able time and again in his laboratory to produce a perfectly good heart beat of fine rhythmic quality in a mere cotton lamp wick steeped in cabbage juice.

To find these pulsations in living tissue, even in an organism so low in

the scale as a humble garden vegetable, is at least in line with what one might expect. But what shall be said of their appearance in inert and lifeless matter?

The answer to this question is a very simple one. I confess frankly that what in my experiments presented all the earmarks of a heart beat (to mix two metaphors) was nothing more or less than poor technique—when it did not happen to be caused, as it was in this particular instance, by simple molecular attraction. I could and can obtain nothing resembling a pulsation when I guard my apparatus rigidly

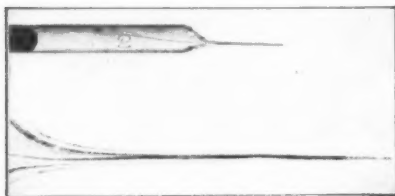


PLAN DIAGRAM OF THE SPHYGMOGRAPH

Figure 2: Lever *d* is pivoted at *b* and balanced by counterweight *a* and, under tension from spring *e* through thread *f*, bears against plant stem *c*. Light from source *k* passes through lens *j*, is reflected from mirror *g*, and is brought to a focus on scale *m*. Infinitesimal expansion or contraction of stem *c* is communicated through lever *d* to mirror *g*, which rotates slightly and causes movement of the light on the scale. Compare with Figure 1, at top of page

from all external influences that may affect it.

If you should ask me to give you with similar directness and brevity my views of the findings of the eminent Indian investigator, I should hazard the opinion that they represent what



THE ELECTRIC PROBE

Figure 3: Top—About normal size, Bottom—tip magnified three diameters

psychoanalysts call a "wish fulfillment." In plain language, I am forced to the conclusion that Sir Jagadis found heart beats in his plants because he wanted to find them there. They were what he was looking for.

My attitude toward the distinguished Indian savant is one, on the whole, of respectful admiration. I acclaim his 30 years of inspired investigation into the dark places of plant life, upon which he has thrown much light. But I do feel that in the conclusions he has reached in his latest book he has allowed his emotions to run away with his reason.

What this well-known master of plant lore has proved by a great many able experiments is that plants respond to stimulation just as animals do. He has found that they react to changes in their environment in a manner closely akin to that in which we humans meet the varying vicissitudes of life; that their growth and vitality depend, like ours, upon the quality and quantity of the nourishment they obtain; that they can be poisoned and depressed, stimulated and revived by drugs and similar substances, exactly as we are—in a word, that they are in many ways creatures like ourselves, with more than a hint of the susceptibilities for which we are famous.

ALL these contributions to our knowledge of vegetable life, despite the occasional poetic fervor with which they were expressed, have been of great value and have gained a well deserved reputation for their author.

In "Plant Autographs and their Revelations," Sir Jagadis explains what one English editor, himself a well-known scientist, terms "his crowning achievement," the discovery that "sap in the plant is propelled by a mechanism which is essentially similar to that which maintains the circulation of the blood." He describes many of his own experiments which, in his opinion, make good this claim, and offers numerous illustrative diagrams showing the curves or electrically

drawn records produced by the plants themselves by means of what he calls their "pulsations."

There is no denying the close apparent similarity between these diagrams of the pulse of plants and the cardiograms, or electrically made autographs of the human heart beat, (D, Figure 9) which the modern doctor turns out daily for his patients in the course of a complete physical examination. Is this similarity merely one of external appearance, or are the causes behind the records in the two cases also similar in kind? I will try to present as clear a résumé as possible of the experiments conducted in my laboratory at Mount Clemens, Michigan, with a view to answering this question.

The Indian scientist describes in his book different highly sensitive devices or apparatus to which he harnessed the plants he employed in his experiments. One of these was an electric probe, consisting of a tiny, pointed wire connected with suitable measuring instruments. He tells us that he pushed the point of this probe into the stems of plants a hair's breadth at a time, in order to find what he calls "the sensitive layer" in the tissues of his subjects. Through this probe he obtained electric currents or pulsations that indicated the heart beat, or its equivalent, in the flowers and vegetables upon which he experimented. He introduced infinitesimal doses of poison, such as strychnine, into the plants and found that these heightened the pulse beat. He increased the dose and found that it stopped the beat altogether.

HAVING thus briefly outlined his recent researches into plant circulation, so to term it, I will explain how I came to investigate the matter. I am interested professionally in a group of diseases caused by what are known as toxins—poisons produced in the human system by harmful bacteria. In my laboratory my assistants and I do much experimental work with rabbits, rats, and guinea pigs, in order to study the action of these poisons and to try to find remedies for them. The work of Dr. Bose with plants came to my attention and I believed I saw in it a possible way for rapidly testing out these toxins as an aid to the treatment of the conditions caused by them in human beings. So my two assistants, Dr. Willard H. Bennett and Mr. Walter A. Greig, and I decided to attempt some of the experiments made at the Bose Institute, with a view to familiarizing ourselves with the technique of plant experimentation.

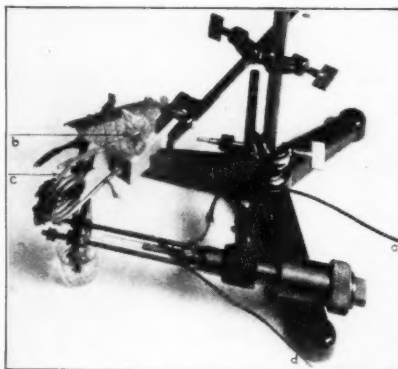
First of all we made an electric probe similar to that described by Sir Jagadis in his book. This probe consisted of a glass capillary tube drawn to a fine point, through which was led a platinum wire one two-hundred-and-

fiftieth of an inch in diameter (Figure 3), in such a way that all but the tip was electrically insulated. The probe was mounted on a screw device having a very fine gage for measuring its tiniest movement accurately down to one 2500th of an inch. A photograph of the set-up of the probe is shown in Figure 4. Great care was taken to permit electrical contact nowhere else but between the probe tip and plant stem.

IN circuit (a, d, Figure 4) with the probe was placed a galvanometer, suitably protected from vibrations in the building by being mounted on a heavy brick pier, which in turn rested on eight rubber stoppers. The natural vibratory period or swing of the galvanometer, an exceedingly delicate instrument, was also determined, so as to be allowed for in all experiments.

Light from a heavy filament lamp was focused on an aperture $\frac{1}{32}$ of an inch in diameter, which was placed five feet, four inches from the mirror of the galvanometer. In front of this mirror was mounted a lens which focused the beam to an image five feet, four inches from the galvanometer. At this focal point a camera was set up which could move a two-and-a-quarter-inch film at any speed between four inches and 40 inches an hour.

With this apparatus in operation, if there were no pulsations in the plant, to be registered by the galvanometer as deflections, the film would show a



SET-UP OF PROBE AND LEAF

Figure 4: The electric circuit was completed through the heavy conductor a, the platinum wire in the probe, the probe tip, the epidermis of the leaf stem, the tissues of the stem and leaf, the epidermis of the leaf, the platinum wire b, the metallic leaf-holder c, and the heavy conductor d. When a leaf on a growing plant was used, the circuit was completed through a metal electrode in the soil, not through leaf

perfectly straight line from end to end. If, on the other hand, there were pulsations or other changes in the plant, producing an electromotive force, the galvanometer would be deflected, and such deflection would be recorded as a V-shaped notch or break in the line on the film.

Sir Jagadis states in his book that he used the plant *brassica* in producing

some of his curves. Since *brassica* is a genus of plants including the cabbage, cauliflower, turnip, and their near relatives, we picked the turnip as best for our purposes because it possesses a leaf with a stem. We also made measurements on *cosmos*, *antirrhinum*, *dahlia*, and other plants employed by Dr. Bose in his investigations. With all of these we obtained practically similar results.

WE set about our experiments with the idea of recording the pulsations described by Dr. Bose as occurring in the stems of plants due to the sap flow; also of measuring the changes produced in these pulsations by treatment of the stems with various drugs and preparations.

With every faith in the authenticity of the astounding results reported by the Indian scientist, we were naturally prepared to find these duplicated in our laboratory. In spite of the most scrupulous care in carrying out the technique somewhat scantily described in "Plant Autographs and their Revelations," we found ourselves utterly unable to produce the effects we looked for, or to discover anything in the nature of rhythmical pulsations in the living plant tissues.

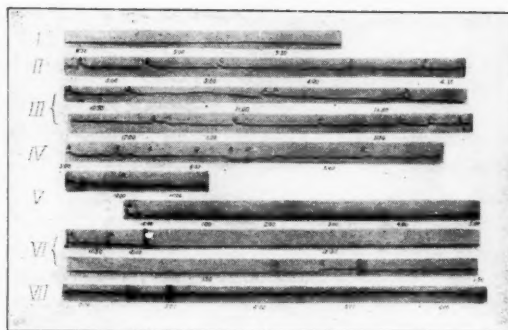
Time and again we repeated the experiments, using apparatus of far greater delicacy than that described by Dr. Bose, but without obtaining the ghost of what we could regard as a genuine pulsation. We finally came to the conclusion that the facts, as we found them, should be given to the public.

Our experiments were made both with leaves taken from live plants and leaves still attached to living plants growing in pots. They were carried on indoors and out of doors, by day and by night, and under greatly varying conditions of temperature and light. The films obtained in a few typical cases out of the very large number actually made are grouped on Figures 5, 6 and 7.

During a number of these experi-

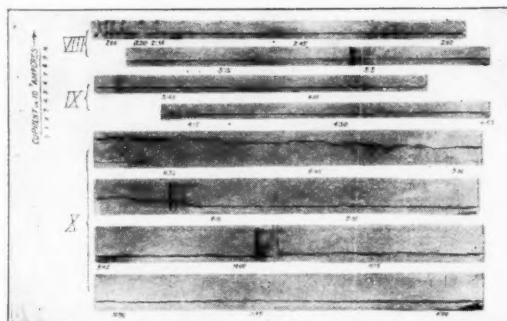
ments our aim was, if possible, to locate the "sensitive layer," consisting of vascular nerve strands described by Bose in his book, as existing at a certain depth within the tissues of the plant stem. In order to try to reach this layer we would from time to time advance the probe more deeply into the stem by about one 250th of an inch. In this way we hoped to spot the layer by finding a decided increase in deflection of the galvanometer when we reached a certain depth, but were not able to do so. In other cases we were simply seeking for pulsations at any depth, or for other possible reactions on the part of the plant to different environmental changes.

Our first two films, made by way of



SOME OF THE CURVES OBTAINED

Figure 5: These are explained in the text. The time durations are shown by numerals beneath the curves. Bracketed curves are continuous with one another



ANOTHER GROUP OF CURVES

Figure 6: The little flutters which show in curves X are attributed to the natural drift of the galvanometer

a check on the remainder, were not taken with growing or fresh cut leaves. One was made with the wires leading to the probe disconnected and free, and the other with the probe in contact with a dead and thoroughly sterilized stem. In both cases the films showed no deflection of the galvanometer—that is, no pulse—whatsoever, but merely a very faint vibration probably due to disturbances in the air of the laboratory. Curve 1 in Figure 5 shows this type of record, practically a straight line. The figures beneath it, as under all the curves, indicate the hour of the day, the film in this case having been run from about 8:25 to 9:45.

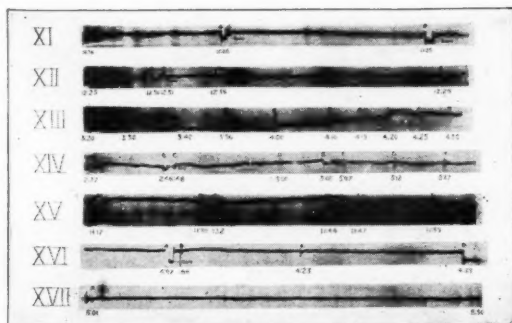
Brackets at the left of curves show that the films concerned were run as continuations of each other. The letters A, B, C, D, and so on, above each curve indicate points at which something was done by one of the experimenters. Either the point of the probe was pushed forward a tiny fraction of an inch, about

one 250th as a rule, in search of a more sensitive layer of tissue—making the jerky breaks seen on curves II and III of Figure 5; or the galvanometer deflection was tested, as at the sudden dips on curve XI of Figure 7; or the plant was watered; or a weak strychnine solution was administered to it; or the light was suddenly increased or decreased; or the camera was darkened; and so on. All the marked or heavy deflections or zigzags in every one of the curves shown were caused, not by spontaneous activity on the part of the plant, but by some action of ours, some change introduced into the conditions by one of us. For example, every time the probe point was advanced a fraction of an inch it penetrated new tissue having a different electric potential, thus causing a slight flow of current in the circuit and a corresponding dip in the curve recorded on the film.

Some of the curves are more tremulous or wavy than others—for example, curves IV and VII on Figure 5 and curve X on Figure 6. These records were taken out of doors and we believe that disturbances in the air and vibrations of the soil may possibly have had something to do with this.

IT is possible also that the wilting of the leaf, which occurred during curve IV of Figure 5, caused small contractions of the stem, which would move the tissues of the plant little by little in relation to the probe tip, causing a series of minute deflections in the galvanometer owing to the change of electrical potential thus encountered.

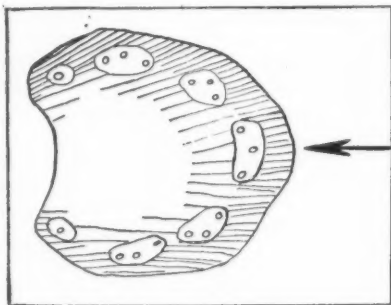
Be this as it may, we found that, as we went along, our curves, which at first had been decidedly wavy, became more and more like straight lines, except for the breaks or dips caused by something we did to the plant or the apparatus. We began to suspect after a while that this was due to an improvement in our technique, and made a number of experiments to learn if this were the case. We finally satisfied ourselves that it was.



A THIRD SET OF CURVES

Figure 7: Compare these with curve C of Figure 9, which Sir Jagadis Bose regards as proof of a heart beat

Our reasons for arriving at this conclusion were, in part, that we found that while the films were being run, walking about the room, a very large one having a concrete floor; or merely standing still in the neighborhood of the apparatus and moving one's hands,



CROSS SECTION OF PLANT STEM

Figure 8: Showing sensitive areas and vascular strands. Arrow indicates probe

arms, or body; or turning the electric lights on or off; or even blowing softly on the galvanometer wires—all had a more or less marked effect on the curve, sometimes quickly passing, sometimes lasting for an appreciable period. These effects were partly of a mechanical and partly of an electrical nature, being due in some cases either to vibrations in the floor of the room or to air currents produced by our movements, and in others to the electric charges in our bodies which gave rise to induced currents in the galvanometer circuit when we approached it.

BY taking the greatest care not to go near the apparatus unnecessarily; by moving, when we had to move, as softly and as far away from the instruments as possible; by improving the insulation of the conductors; and by taking other precautions indicated by our tests as likely to prove helpful, we were able practically to eliminate the waviness, or what Dr. Bose would call the "pulsations," from our later films. Curves made by starting the apparatus and then leaving the room for an hour or more at a time, locking the door to keep out intruders, resulted in straight lines with no sign of any pulsation, and only an occasional very slight waviness which could readily be explained by galvanometer drift, something that can not be avoided when using an instrument of such great sensitiveness. Curve XVII in Figure 7 is a typical example of such a film.

The test made with the circular lamp wick, to which reference has already been made, was carried out as a check, and in order to see what would take place in the case of a loosely woven column of non-living material saturated with a liquid of approximately the same density and chemical character as the sap of the plant. We

allowed the wick to stand in a beaker containing juice squeezed from a fresh cabbage leaf, and connected it in circuit with the electric probe exactly as we did the plant stem. The curve resulting from this, which would seemingly indicate a vigorous heart beat, is shown at E, Figure 9. The heavy dip in this curve was caused by our testing the galvanometer deflection for a moment, and the wavelike character of the rest of the record was probably due to irregularity in the capillary flow at the point immediately adjacent to the probe tip.

In certain of the curves we obtained, as for example in Curve X of Figure 6, there are to be found here and there short successions of waves of a period of about ten seconds, the natural period of the galvanometer we used, interspersed with a larger number of random deflections which it would seem to us absurd to liken to a heart beat. We believe these waves to have been caused by external influences.

Now, had we selected certain parts of this curve, we could have presented something very like the curves published by Sir Jagadis, but it seems to us that the only truthful way in which to report an experiment of this sort is to give every curve in its entirety, as we do in all cases. To pick spots that fit in with one's theories is, to say the least, somewhat misleading.

CURVE A of Figure 9 is an example of the deflection traceable to manipulation. The dotted line indicates a condition of drought; the continuous line a period of watering. Opposite this, at B, are the results, due to poor technique, obtained in some of our preliminary experiments. These, if accepted at their face value, would have provided good evidence for a heart beat. For purposes of comparison, curve C is borrowed from Sir Jagadis Bose's book. It shows records of electric pulsations under alternate drought (dotted line) and irrigation (continuous line). Curve D, also included for purposes of comparison, is a cardiogram showing the beat of the human heart. Upon studying curves A and C together, it will be noted that in both cases considerable activity is exhibited during the watering period. So far as curve A is concerned, we are convinced that this was due to handling, and not to vital processes within the plant.

Besides constructing the electric probe we also went to great trouble to build a sphygmograph according to the scanty specifications given by Sir Jagadis. This is an instrument normally used for recording the character and strength of the pulse beat. We made this sphygmograph as sensitive as modern mechanical knowledge permits. A picture of its set up is shown in Figure 1, to which Figure 2 cor-

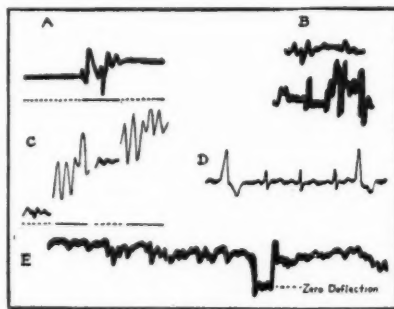
responds. The highest sensitivity was found when the amplifications were 260,000 times. Careful observation with this instrument showed no pulsation whatever in the diameter of the stem of the plants used, which were *cosmos*, *antirrhinum*, and *dahlia*, Dr. Bose's own specimens. We should be greatly interested to see the complete specifications of the sphygmograph with which he obtained the amplifications of 10,000,000 times, as he states.

IN conclusion, I wish to draw attention to Dr. Bose's deep conviction of the essential unity of all life, a conviction which he himself voices in no uncertain terms and which is implicit in much of the philosophy of India, his native land. This attitude of mind may have unwittingly colored the conclusions he draws from his experiments.

To quote his own words, as printed on the final page of the appendix to his book:

"India through her habit of mind is peculiarly fitted to realize the idea of unity and to see in the phenomenal world an orderly universe. It was this trend of thought that led me unconsciously to the frontiers of different sciences and shaped the course of my work in its constant alternation between the theoretical and the practical."

It will be left to those who have read thus far to decide for themselves whether or not this trend may have been the father to the finding; and if the philosophic theories of the Indian



FIVE INTERESTING EXHIBITS

Figure 9: A, Effect of irrigation. B, Poor technique. C, From Sir Jagadis Bose, "Plant Autographs and their Meaning," reproduced by courtesy of the Macmillan Company. D, Cardiogram, reproduced from Bishop, "Heart Troubles," by courtesy of Funk and Wagnalls. E, curve produced by lamp wick in cabbage juice

writer may not have influenced his scientific judgments.

During the last glacial epoch a part of the area of Alaska escaped the covering of ice which removed various evidences of fossil, and possibly human, life. In a subsequent issue an Alaskan geologist will set forth plans for investigating this promising area.

OUR POINT OF VIEW

A Greater Merchant Marine

THE news that the government has sold the United States Lines and is, therefore, out of the shipping business, has been welcomed by many throughout the country. The nation has in late years become "merchant marine minded," and there has been much discussion of the problem of building a system of shipping lines that would be second to none in the world. Governmental operation of such lines has been criticized a great deal but the principal criticism seems to have centered around the fact that, due to the question of the status of the United States Lines—that is, what final disposition would be made of them—there has been little chance for expansion and development.

Mr. Paul W. Chapman, to whom the lines were sold, already controls about 90 electric, gas, railroad, water, and other companies and has been so successful in the operation of these that it is predicted that he will be eminently successful in his new venture. A good indication of the high repute in which Mr. Chapman is held and an augury of the probable progressiveness of the lines under his management, may be seen in the fact that banking interests, hitherto indifferent to shipping, have evinced a desire to participate financially in their operation.

Our renascent merchant marine will now, no doubt, claim a greater measure of public attention than it has since the war. That intangible thing called prestige will account for much of that attention; the necessity for a larger merchant marine which might be used as a naval auxiliary in time of war will account for more; and the fact that our constantly increasing production and export trade requires American bottoms in great numbers, will share perhaps the greatest. Another important feature to be considered is that private operation of these lines will probably stimulate American shipbuilding. The new owners are bound by the terms of the sale to build two running mates to the *Leviathan* and are already considering construction of five smaller ocean liners.

The Summer Fight

EARLY in March the city of New York appropriated 100,000 dollars with which to wage an intensive anti-mosquito fight. Breeding grounds are to be drained or covered with oil, and the assistance of the public is to be enlisted through the medium of literature distributed to Boy Scouts.

Many other communities will make similar fights during the coming summer—for a very good reason that may be stated statistically. -One lone female mosquito can produce 159 billion offspring in one year, according to Dr. Thomas J. Headlee, chief entomologist of the New Jersey Agricultural Experiment Station. About half of these are males which do not

should be covered with almost any kind of oil that will exclude air from the surface. Tin cans, when thrown on a dump, should always be punctured in several places so they will not hold water.

Prevalence of mosquitoes not only constitutes a health hazard, but also may have a direct effect on real estate values, especially in the case of summer resorts. Therefore even selfish people have a strong incentive to aid in the fight. But, regardless of the motive, may the fight go on relentlessly until these vampirish insects are under control and the percentage of bitten ankles is materially lowered.

Aviators Do Die Naturally

THE opinions of the great majority of people are as changeable as the tides; they ebb and flow and are never quite the same from one day to the next. At present they are wavering back and forth on the question of the relative safety of aviation. No sooner has the tide of public opinion swung to the side of confidence in aviation than it promptly swings back to the side of distrust because two or three unavoidable accidents have occurred.

Airplane mileage figures are repeatedly cited to show that the percentage of accidents is very low and yet the distrust continues. Strangely, almost a wave of horror will sweep the country when news of an airplane crash is published, although scarcely any attention is given to the large daily toll of lives in automobile and railroad accidents.

From France come some interesting figures which should rather definitely prove that aviation is safe. Out of the first 101 pilots to receive certificates from the International Federation of Aeronautics, it is said that 67 are alive today. Only 12 of the others have died in actual service in the air, and the remaining ones all died natural deaths. Perhaps this is proof enough for the time being but most of those who read it will change their minds when they read in tomorrow's paper of the death of one student flier; the few hundred automobile fatalities won't count.

bite, Dr. Headlee says, but the other half!—biting, pestiferous, disease-carrying females.

New York City and other communities which started the fight early are to be complimented on their foresight. Other communities and even individuals who have been remiss should not hesitate to enter the fight at once. Rain water in tin cans, barrels, roof drains, or yard depressions are favorite breeding grounds for these pests and are often found to be full of the wrigglers. Such containers should be emptied, drained, or the water therein

Thug Gas Warfare

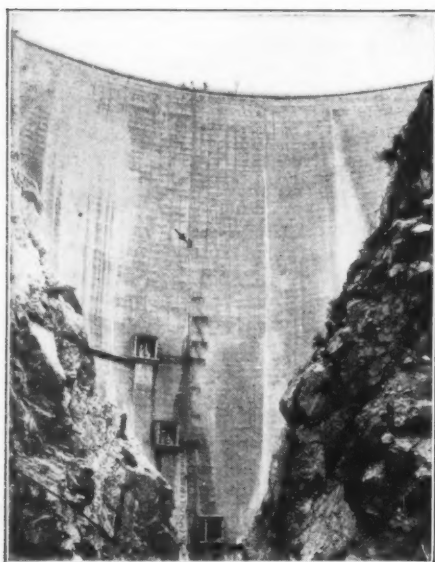
RECENTLY a judge made a statement to the effect that he would be inclined to be much more lenient with a hold-up man who used tear-gas in committing a robbery than he would with one who used a pistol. He gave as his reason the well-known fact that the victim of a hold-up who is shot often dies or is maimed for life, whereas tear-gas would simply incapacitate him for a few minutes and would have no after effects.

There is nothing unethical in the judge's attitude, for to all who have any knowledge of non-toxic gases, the popular prejudice against the use of them by the police is incomprehensible. At this writing, the Police Department of the city of New York is contemplating the adoption of gas and the passing of an ordinance that would make possession of any sort of gas gun by a civilian a felony comparable to that for possessing a pistol. Police armed with a few bombs containing this gas or special pistols for shooting it could effectively disable criminals temporarily so that they might be captured without bloodshed.

So far, so good; but criminals should be encouraged to use gas instead of pistols. The arming of police with gas would tend to have the effect of causing the thug to abandon his pistol since his own life would not be in such great danger; consequently the lives of many citizens and policemen might be saved. If possession of a gas-throwing device should be as felonious as owning a pistol, he might hesitate to make the change. Certainly he should be punished for carrying gas, but the law governing this should not have too sharp teeth. It is better that fewer murders be committed than that we attempt by bloodshed to save the few paltry dollars thugs might more easily obtain by using gas.

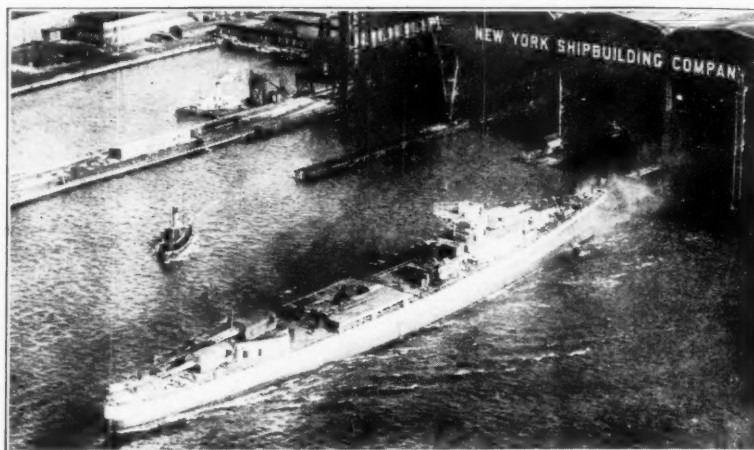
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From the Scrap-book of Science



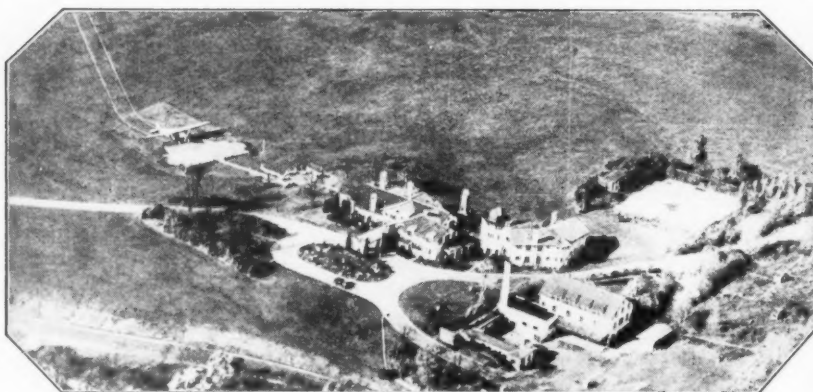
WORLD'S HIGHEST

The arrow points to a man working on lower face of Pacoima Dam, 376 feet high, near San Fernando, California. Built by Los Angeles County, it took four years to build, cost 2,500,000 dollars, is 660 feet long at top, with a base 100 feet thick



THE LATEST ADDITION TO OUR FLEET

The *Salt Lake City*, first of eight 10,000-ton cruisers now being built by us under the terms of the Washington Conference, takes to the water at the Camden, New Jersey, yards of the New York Shipbuilding Company. She will have 10 eight-inch guns, four five-inch guns, and six torpedo tubes. She was laid down in 1927



THE FAMILY PLANE MAKES ITS BOW

Predictions have been made by many people that the time is near at hand when planes in great numbers will be used privately, and indications point to the fulfillment of that prediction. This illustration shows the private airplane owned and used daily by Colonel E. A. Deeds, New York banker, at anchorage on the grounds of his country estate at Dayton, Ohio. The plane may be seen in upper left corner

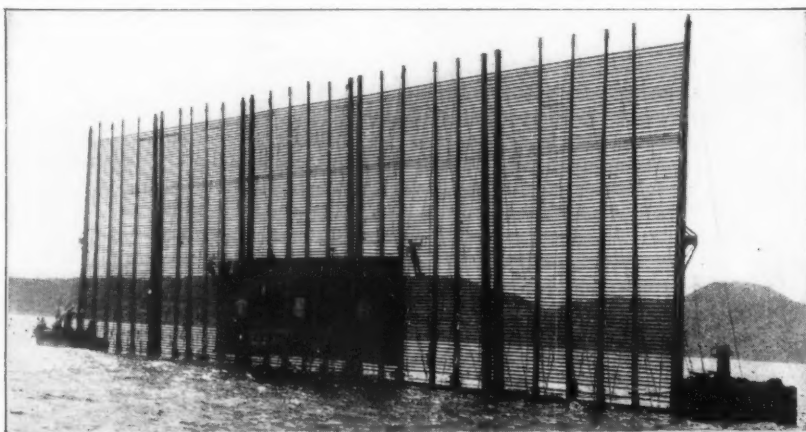


ROACHES EAT BOOK COVERS

Materials generally used for filling and finishing book covers are relished by roaches. These insects do not attack unfilled cloth bindings or those of a water-insoluble nature or finish. Books can be roach-proofed by the method used by Mr. R. W. Frey, of the Bureau of Chemistry and Soils, who paints book covers with a lacquer

← HOW SKILLFUL ARE THEY?

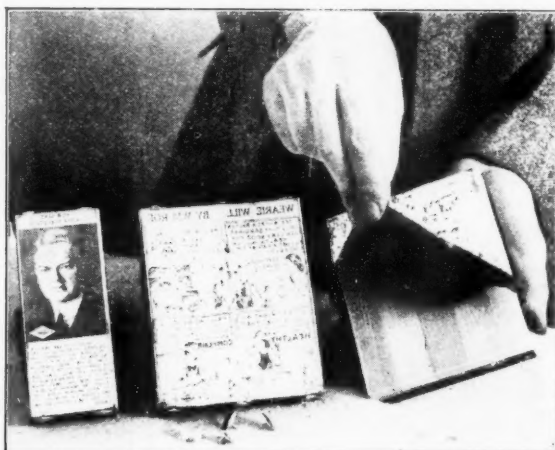
A close-up view of a target used by the navy for testing the skill of gunners. This particular target is being adjusted by sailors of the *U. S. S. Pittsburgh* in Merivales Bay near Manila in the Philippines, preparatory to night firing. The target consists of a lattice-work on a partially submerged raft, with a canvas bull's-eye. It is towed far behind a fast vessel





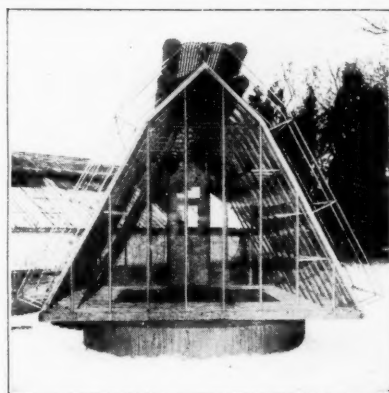
INSTALLING A BRIDGE SPAN WITH "MOON POWER"

Engineers on the 7,500,000-dollar highway bridge across San Francisco Bay (longest in the world—see SCIENTIFIC AMERICAN February, 1929) laid careful plans to use the tides—i.e. moon power—to install the huge lift span. Accordingly, the 303-foot span, weighing 613 tons, was installed on barges at a height previously calculated accurately, was floated into place during high tide, and was slowly installed in its permanent position as the receding tide lowered it. The operation was successful



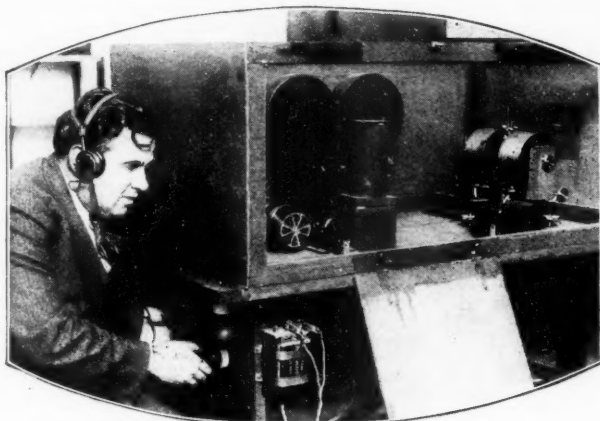
PAPER PRINTING PLATES

The printing industry, which has long depended on heavy metal cuts, is stirred up over the announcement of a newly-invented printing plate which is so light that it can be sent through the mail as first class matter and yet is strong enough to stand more wear and tear than metal. Fred C. Goldenbaum is the inventor. The plate is produced under a pressure of 4500 pounds. It is being used by many daily newspapers and weeklies in the United States



FOLLOWING THE SUN

A patent has just been issued to Mr. Albert C. Burrage, president of the Massachusetts Horticultural Society, for a rotating greenhouse such as the one shown here which he has erected at Orchidvale, Massachusetts. Although only 12 feet square, it provides space for 10,000 seedlings on its shelves. As it rotates with the sun, the seedlings always receive sunlight



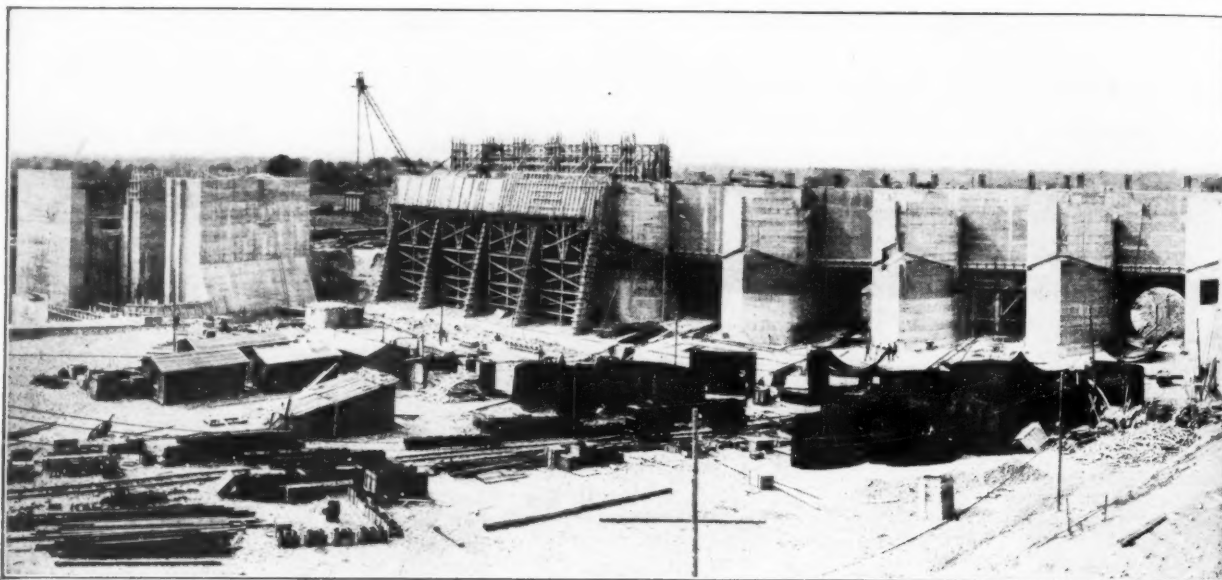
THE HEART ON THE "MOVIE" SCREEN

Although the X ray depicts the phases of the heart in action, it shows only the heart. The stethoscope gives only the sound of the heart action. By means of a new machine, the osciographoscope, invented by Lieutenant E. H. Hansen, of Los Angeles, slight changes of heart pulsation may be photographed by a "movie" camera, recorded on a phonograph record, and shown on a motion-picture screen



DAYLIGHT ROBBERY IN THE ANTARCTIC!

This photograph, taken within 200 miles of the South Pole, shows some of Commander Byrd's wild neighbors, permanent residents of barren antarctic lands. A penguin's nest is raided by a hungry seagull while the adults attempt, rather futilely it seems, to do something about it. This photograph is remarkable in that the seagull seems utterly oblivious of the camera man. Penguins are always tame



All illustrations courtesy Siemens-Bauunion G.m.b.H.

THE LOWER END OF THE HEAD RACE

Intake sluice building from the head race side showing openings for the penstocks, the one at the right being open. One of the cable

crane towers can be seen in the distance. The size of the work in this forebay may be compared with men near the penstock openings

Where the River Shannon Flows

A Huge Hydro-electric Plant, Being Built on This Great River, Will Add Greatly to Ireland's Power Supply

By F. D. McHUGH

UP near Sligo on the west coast of the Irish Free State, a river rises in County Cavan and starts somewhat proudly on its way to the sea. Very soon it broadens out into a lake, beautiful Lough Allen, passes on southward through Leitrim, between Counties Roscommon and Longford, through Lough Ree, past Athlone and Counties Westmeath, Galway, Offaly, and Tipperary, through Lough Derg and County Clare, and on down to the sea below Limerick. The stream which thus almost cuts off nearly a fourth of Ireland is the River Shannon, famous in song and story, and a symbol of the Emerald Isle; it is a river dear to the hearts of millions of Irish people throughout the world.

The waters of this world-famed river are being harnessed. A great hydro-electric project is in process of construction at Ardnacrusha near Limerick and, when this is completed, long high-tension transmission lines will carry its electrical power to practically all of Ireland.

The economic significance of this scheme can be realized when it is understood that the area to be supplied with power from this one source is over 25,000 square miles, that the plant is 120 miles from Dublin which is the

largest established center of consumption, and that high-tension lines up to 225 miles long will be needed. Furthermore, this plant will practically triple the present electrical supply of the Irish Free State. While this is far more than the present economic situation of essentially non-industrial Ireland demands, the entire project was predicated upon the prospect of rapid expansion of industry, of the establishment and importation of new industries, and the possible use of River Shannon power on farms, for the cheap manufacture of chemicals, et cetera.

THE work now in progress was decided upon by the Irish Free State early in 1925 following the favorable report, rendered by a commission of experts, upon the proposal that had been submitted by a firm of German engineers. The Shannon Electricity Act which was passed in June of that year authorized the beginning of construction of the first stage of the project. The total installation will give the plant a capacity of 180,000 kilowatts in six generators of 30,000 kilowatts each, while the so-called "partial development," now under construction, will consist of only three generators with a capacity of 90,000

kilowatts. The partial development will include:

1. Excavation and erection of embankments along the Shannon between Portumna and Banagher.
2. Damming of the river between Lough Derg and the main weir.
3. Erection of the weir at Parteen Villa and of the intake building to the head race.
4. Construction of the head race from the weir to the power station at Ardnacrusha, a distance of nearly eight miles, with the embankments, syphons, culverts, and bridges.
5. Construction of power station and the two navigation locks at Ardnacrusha.
6. Construction of the tail race.

The cost of the first stage of the work will be in the neighborhood of 15,000,000 dollars exclusive of the network of transmission lines and the switch house. Of this amount about 2,500,000 dollars will be expended for the electrical and mechanical parts. The work on the partial development was started in 1925 and it is expected that it will be completed this year.

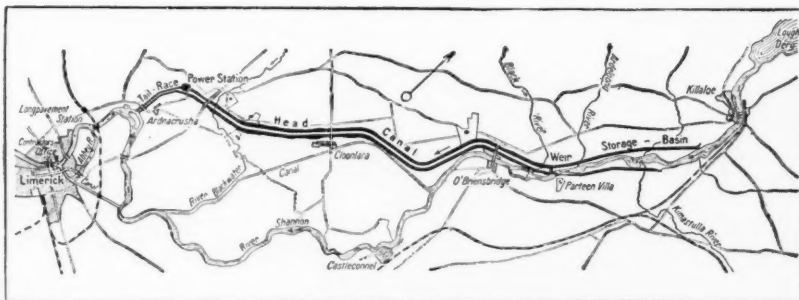
The watershed of the River Shannon, an area of 4000 square miles, is about one sixth the area of, and the largest drainage area in, Ireland. It has comparatively little fall in its upper and middle

reaches but between Lough Derg and the tidal estuary near Limerick the fall is fairly high. Consequently the upper portion with its three large lakes—Allen, Ree, and Derg—with a total area of 99.5 square miles, is suitable for impounding water. The fall of 92 feet between Lough Derg is to be utilized for power generation in the new plant. Also the waters of only Lough Derg are to be used in the partial development. In this lake the level will be regulated to provide a useful storage of 6,568,000,000 cubic feet of water. Earth embankments will be constructed at low points on the shores of this lake to prevent flooding of the land which, in turn, will be drained by pumps.

Lough Allen and Lough Ree will be utilized in the further development, or second stage, to store 20,234,922,000 cubic feet of water. In the last stage—the final development—the level of Lough Derg will be raised so that the total storage of the three lakes will be 29,204,000,000 cubic feet.

ALTHOUGH the project is primarily a power generating scheme, it also takes into consideration the question of navigation. When the partial development is complete, barges of 150 tons capacity can go up the tail race, through locks at the power plant, and out into the river again through the ship's pass at the intake building. Previously, barges of only 40 to 60 tons capacity could negotiate the locks between Limerick and Lough Derg, although locks at important points above this lake already accommodate 150-ton barges.

The scheme will also have an effect on agriculture since floods are to be controlled and certain



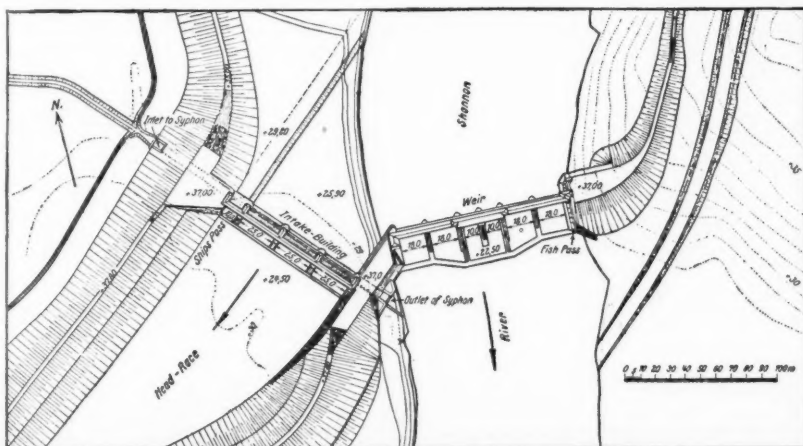
THE RIVER SHANNON SCHEME

Map of the district in which the hydro-electric project is being constructed, showing the main weir near Parteen Villa, the head race, the power plant, and the city of Limerick



THE TRANSMISSION NETWORK

Comprehensive plan of the high-tension lines over the Irish Free State, with the exception of 10,000-volt lines



WHERE THE WATERS DIVIDE

The main weir, which diverts the necessary amount of water from the river into the head race, intake building, fish pass, and ship's pass are shown. (Dimensions indicated in meters)

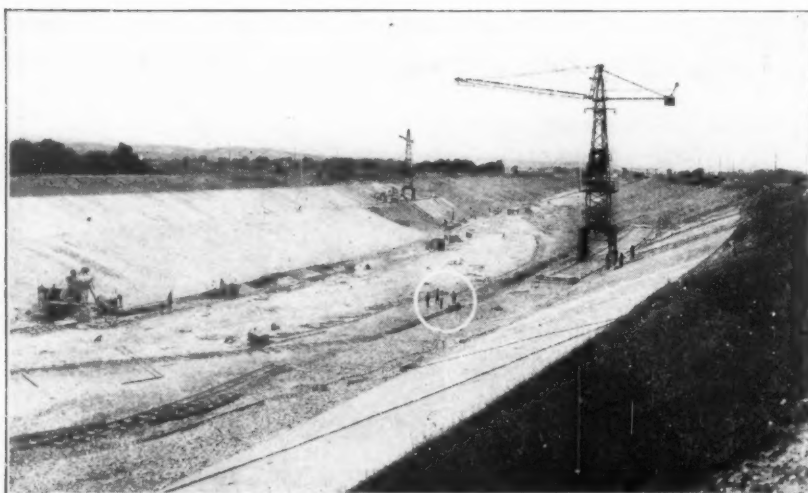
land is to be kept drained. The completion of the partial development alone will make arable 12,000 acres. A fish pass was constructed at the main weir to allow salmon to reach their spawning grounds.

At the principal weir, which is in effect a dam, the water level will be 25 feet above the present average level, thus necessitating construction of earth embankments extending some distance upstream. The Ardlooney River will discharge into the Shannon above the weir and the Blackwater and Kilmastulla Rivers will be diverted along the head race and eventually discharge into the Shannon below the weir.

THE weir has six openings—four 59 feet wide and two 32.8 feet wide. The outer openings are closed by steel roller sluice gates each 59 feet wide and 8.85 feet deep; the intermediate openings by similar gates 59 feet wide and 10.65 feet deep; and each of the 32.8-foot center openings will be closed by a double roller gate divided horizontally and having a total depth of 35.8 feet. The electrically operated hoisting machinery will be housed in a gangway which covers the weir.

At the intake building three flow openings 82 feet wide, and one 32.8 feet wide for ships, have been provided. Three undivided steel roller sluice gates 82 feet wide by 18.7 feet high and one 32.8 feet wide by 19.35 feet high, all electrically operated, control the flow through these gates. The Black River flows under the intake building through a syphon and into the Shannon.

From the intake building the head race extends a distance of about 7.8 miles to the power plant. This race was so planned as practically to balance cuts and fills, the earth obtained from the excavations being used where embankments were necessary. The dimensions of the head race are: bed 103 feet wide; maximum width at water surface 295 feet; and maximum



SOILING AND CONCRETING EMBANKMENT SLOPES

Two swivel cranes on tracks in the bed of the head race. These machines command the entire slope from top to bottom and handle earth and concrete. Note size of men in circle

depth of water 36.8 feet. The side slopes are lined with a strip of concrete that extends 23.6 inches above the highest water level and 23.6 inches below the lowest water level. The bed and the slopes below the concrete strip on each side of the tail race are lined with broken stone to a depth of about 15 inches. Three concrete highway bridges were built over the canal—one at O'Briensbridge, another at Clonlara, and the third near the Blackwater River.

THE power house is being erected at the Ardnacrusha end of the head race. In this there are being installed three 38,500 horsepower vertical turbines, each of which will drive a 30,000 kilowatt generator. Three other units of the same capacity will be installed for the full development. From the head race, steel penstocks 19.65 feet in diameter have already been installed and connected with the spiral cases of the turbines. Roller sluice gates, 20.8 by 21.3 feet control the flow of water to the penstocks.

These gates can be closed in 30 seconds either from the power plant or from the bridge over the intake; and are closed automatically by governors should the turbines speed up above the allowable maximum. To meet the possible necessity of draining the head race entirely a waste channel has been provided. The net fall at the power plant is from 84.4 to 102 feet, depending on the level of Lough Derg and that of the tail race which varies with the tide.

As stated before, long high-tension transmission lines of 110,000, 38,000, and 10,000 volts will carry River Shannon power through almost the entire Irish Free State. From the plant where the electricity is generated at 10,500 volts and stepped up to 110,000 volts by means of transformers, a six-conductor line extends 116 miles to Dublin while a three-conductor 110,000-volt line runs a distance of about 59 miles to Cork. These two lines, which constitute the primary distribution system, connect to transformer stations at the two

cities mentioned and the power is there stepped down to 38,000 volts for further distribution. Later on, the transformer station at Maryborough will be converted into a 110,000-38,000-volt station.

At the Ardnacrusha plant, power is also stepped up to 38,000 volts thus making, with Dublin and Cork, a total of three main feeding stations for the 38,000-volt distribution system. When this latter system is finally completed, the total length of its lines will be slightly over 1000 miles.

A network of 10,000-volt transmission lines will radiate from step-down transformer stations on the 38,000 volt system, thus forming what is known as the local distribution system. On this last named system the power will be further stepped down to 380 and 220 volts at which voltage it will be supplied to consumers in cities, towns, and rural districts.

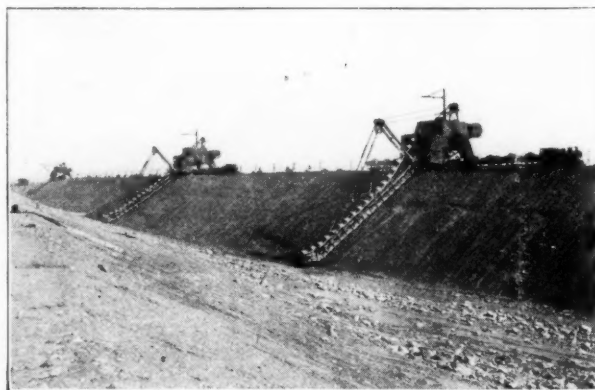
THE construction of the works on this great scheme presented problems that necessitated careful planning of construction plant, selection of machinery to be used, and organization of transportation facilities. Due to the fact that something like 9,150,000 cubic yards of earth had to be handled either in excavating or filling, 1,300,000 cubic yards of rock had to be blasted, and more than 220,000 cubic yards of concrete work had to be constructed, an immense plant had to be laid out. Neither plant equipment nor the materials necessary for the work were available in Ireland and it was necessary, therefore, to import from Germany upwards of 125,000 tons of machinery, fuel, structural wood and iron, et cetera.

Incoming steamers were unloaded in Limerick Harbor by means of an electric derrick crane and two movable oil cranes erected especially for this purpose. From there the shipments had to be transported by motor truck to Longpavement and there shipped by rail on an especially built railway



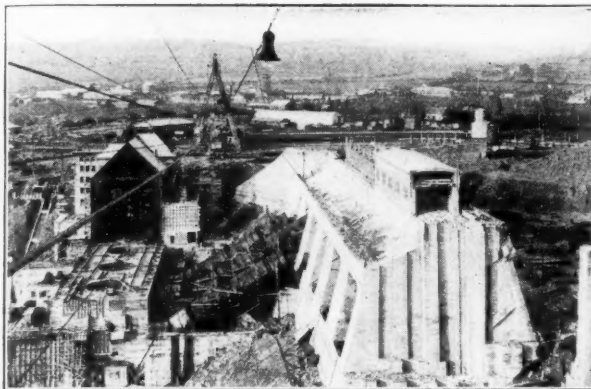
THE TREMENDOUS TRANSPORTER

This machine is described on the opposite page. It is a single machine running on tracks. The material train runs beneath it



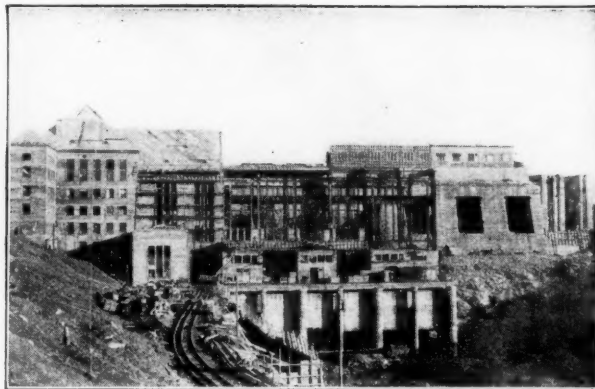
MULTIPLE BUCKET EXCAVATOR

The tracks on which this machine runs are gradually moved back as the work progresses. Material is dumped into train underneath



POWER PLANT SITE

The intake building at the power house partially complete. One of the towers of the cable crane and its cables may be seen here



THE PLANT NEARS COMPLETION

The power plant as it appears from the tail race. It will be noted that openings have been provided for three more penstocks

to the various sites. Most of the locomotives are steam driven but where the track was laid permanently for the duration of the job, they are driven by electricity.

Besides work shops, material and spare parts storerooms, rock crusher, air compressor, smithy, et cetera, a temporary power station having a total capacity of 4500 horsepower in nine Diesel engine units was built. With this power available, it was possible to drive by electricity not only some of the locomotives but also the huge excavators, transporters—in fact, practically all the machinery used on the job.

SHOVEL and bucket excavators were used for removal of surface soil and digging the head-race trench. Since the top soil was unsuitable for building the embankment it was put aside and later used for surfacing the slopes above the concrete strip. The shovel and bucket excavators differ little from the types known in this country but the transporters are worth a few words of description here. Each of these is a gigantic machine weighing 250 tons. It runs on a wide double track of its own and straddles another track on which a train of dump cars may run. The material train dumps its load of earth into a small trench previously excavated by the transporter beside the track. The transporter scoops up this material and drops it on two conveyor belts which, in turn, carry it out on the arm and drop it from a height of 50 feet over a wide area.

Due to the height from which the material is dropped by the boom of this transporter, embankments formed in this manner are very well consolidated since the fall has the effect of ramming in the material. There is, however, a sprinkling device on the lower arm of the boom, to assist in settling the earth by puddling. After the roughly formed embankments are allowed to settle for a while, the slopes and top are dressed by hand labor. Following this a layer

of about eight inches of top soil is placed on the top and outer slope and the inner slope is made watertight. At points where this latter operation is necessary, a layer of about 24 inches of clay is bedded in. Transporters are used for placing this surface material.

The transporters are all electrically driven, power being conveyed to each machine at 3000 volts and stepped down to 380/200 volts by means of suitable power transformers carried by the machine itself.

A SWIVEL crane, running on a track in the bed of the head race, is used for some of the slope-soiling operations, for spreading the stone, and for the concreting work. This crane has a reach of 50 feet and can lift two tons of material. It is driven by electricity. As the work performed by this crane progresses and the crane moves on, it becomes necessary to level off the track on which the crane runs. This is done by means of a roller which is pulled up the slope by a winch car

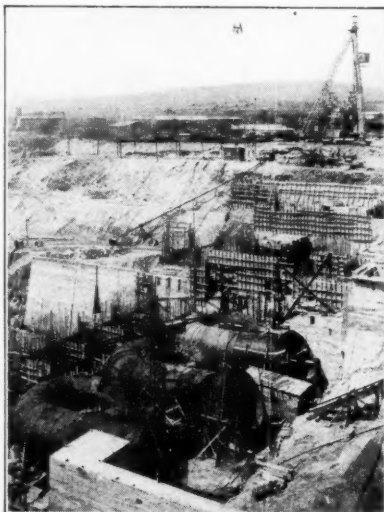
which runs on a track on the top of the embankment. A 25 horsepower Diesel engine supplies the power for pulling this roller up the slope while its weight is sufficient to carry it down.

The tracks of the various machines must be moved sidewise from time to time. This movement is effected by means of a track mover which is pulled along the track by a locomotive and lifts the track bodily over to the new position.

Another feature of the construction equipment worthy of description is the portable cable crane erected at the power plant for doing the concrete work. This consists of two towers, each 118 feet high, which stand on opposite sides of the power plant and are connected by a steel cable 1000 feet long. The concrete is prepared in two mixers in one of the towers, is poured into buckets which move horizontally or vertically on the cable and, since these tower supports move on rails, every part of the site can be concreted expeditiously. A similar outfit was arranged for concreting the main weir.

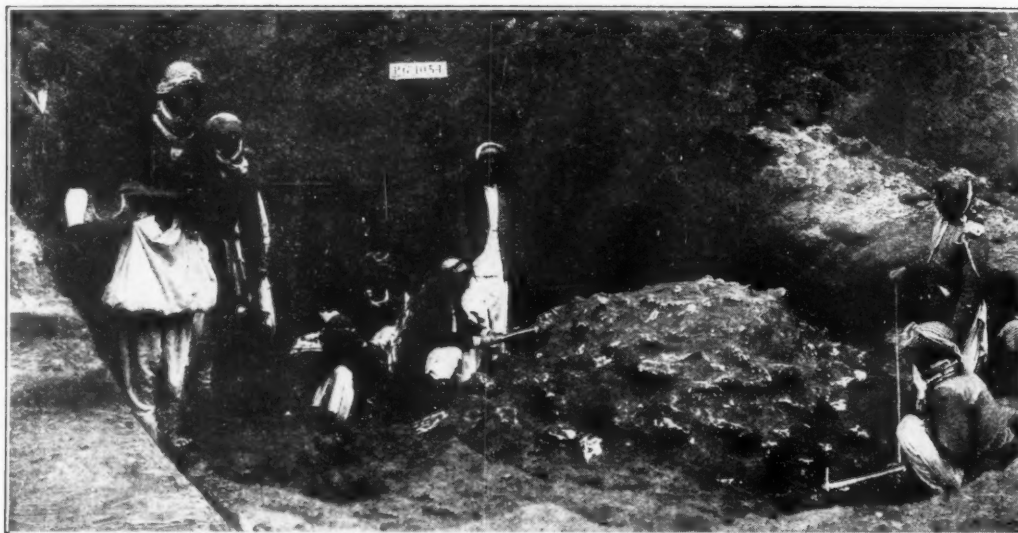
An average of 2500 German and Irish workmen have been employed on the partial development. Several camps with living quarters, recreation huts, and various other facilities have been maintained for these men. The magnitude of the work made it necessary to maintain offices at all the principal building sites and to employ therein a large number of engineers and office helpers. To allow constant and efficient communication between these offices, a network of telephone lines was installed. Communication was assisted by a fleet of automobiles and a motor bus and by a motor boat on Lough Derg.

ALL the work on this project, including engineering and construction, has been and is being done by the Siemens interests—Siemens Schuckertwerke and Siemens Bauunion, G.m.b.H.—of Berlin, Germany.



THE TURBINE CASINGS

Looking down from the intake building. Note tower and the shops in the distance



STONE DOME OF ROYAL PREDYNASTIC TOMB

Domes such as this covered the tombs of Scythian kings. They were constructed of brick or stone in mud mortar

with a centering of wood. The beam holes for this center support are visible here in the side of the mound

New Discoveries at Ur

Excavation of Five Predynastic Royal Tombs May Explain the Origin of the Sumerian Kings of Ur

By LEON LEGRAIN, D.D., Sc.D.

Curator, Babylonian Section, the Museum of the University of Pennsylvania

LEANING over the royal tombs in the predynastic cemetery at Ur, we not only wonder at the treasures buried there, but still more we are impressed by the grim customs now revealed, the wholesale murder and burial of servants and retainers around the grave of their lord and lady when Shub-ad was a queen and Mes-kalam-dug a king in ancient Ur, more than 6000 years ago.

Five royal tombs were discovered last year. Two were intact, and three more or less plundered. Even in ancient days, the lust of gold was stronger than religious fear and curses. The complete tombs were those of Mes-kalam-dug and Shub-ad. Three more royal tombs were identified this year, and only one is still in the original condition.

THE royal burials are distinguished at once by their dimensions, the richness of the offerings, and the strange rites which accompanied them. Private persons were satisfied with a circular or oval clay coffin, or the body was laid in the earth wrapped in matting, with or without a ritual burning, and surrounded by the personal belongings of the deceased—clay, stone, and metal vessels, tools and weapons, and a wonderful display of jewels in gold, silver, lapis lazuli,

carnelian, and shell. But the royal body is buried in a regular vault, built of stone and bricks and consisting of one, two, or three rooms. The tomb is covered with a series of regular brick arches, or with a dome of stone in mud mortar over a centering of wood, which throws an entirely new light on the early history of architecture.

The burial of Scythian kings de-

scribed by Herodotus forms the best commentary on the royal burial of the predynastic kings of Ur and it throws a vivid light on its human and racial aspect. "When the king dies, (the Scythians) dig in the place a great square pit." The digging of the pit once finished, they cover the body with wax, open it, clean it, fill it with crushed aromatic plants, perfumes, and anis seed, and sew it again.



GOLDEN BULL'S HEAD

Below this head were found the four engraved plaques illustrated elsewhere

AFTER carrying the body from province to province across the kingdom, they bring it back to the burial ground, and place it on a state bed littered with branches, under a canopy of willow branches supported by lances stuck in the soil. "In the empty space of the pit, they place one of the king's concubines whom they have previously strangled, one cup bearer, one cook, one groom, his state minister, one of his servants, several horses—in a word, the most precious part of his riches and some gold cups." After this they fill the pit with earth.

At the end of a year they take from among the rest of the servants of the king, those who were the most useful to him. All are born Scythians, not slaves bought on the market, but chosen and ordered for his service. "They strangle 50 of them and 50 of his best horses." They open them,

remove the entrails, stuff them with straw and sew them again. After this operation, horses and riders, mounted on halfwheels or transpierced with long pikes driven through the bodies and stuck into the ground, are left to keep their dreadful watch over the tomb of the dead king.

Such wholesale murders on the tomb of a dead king form a special feature and a racial trait of civilizations existing northeast of the Persian border. They are found not only among the Scythians, but in India, in China, in Japan, and among the Mongolian Indians in Alaska. They may go far to explain the origin of the Sumerian kings of Ur who likely came down in the past from the Elamite hills and who have much in common with the border land. The level of their tombs at Ur is 20 to 30 feet below the level of the Sargonid kings who in 2700 B.C. reigned over a mixed population of Sumerian and Semitic tribes named Akkadians. The Semites may have practiced human sacrifice, at least of their enemies, in honor of their gods, but not in order to procure servants for their dead. They never forgot the right of God to their firstborn, but they knew how to redeem him by a substitution, as in the famous sacrifice of Abraham.

AT the time of the first dynasty of Ur, 3100 B.C., we find that all traces of the ancient Eastern customs prevalent among the predynastic kings have vanished. In contact with the Semitic influence, the old Sumerians lost some of their primitive rudeness. At the utmost, a clay figurine in the tomb may be the equivalent of the

concubine strangled by the royal order.

But if we consider the art of the magnificent objects buried in the predynastic tombs at Ur, we at once realize that they represent not the beginning, but probably the flowering, perhaps the end of a civilization which had its roots in a long, long past. The Sumerian art is then already a classical art, with fixed types and school conventions. Modeling, casting, carving, and engraving have no secrets for the expert craftsmen. Their best pieces show an ideal of force and dignity, not de-

SHELL PLAQUES >

These inlaid and engraved examples of Sumerian art are completely described in the text

void of a certain heaviness, a minute rendering of details, a love of nature and animal life. It is a subtle and curious art which likes inlay and polychromy, and delights in the mingling of colors and materials, and the blending of low and high relief with boldly salient parts in the round. Its style is surprisingly free and is not abashed by the difficult tracing of figures *en face* or the shortening of proportions in perspective. It has even an apparent sense of humour, with a deeper meaning, in scenes where animals play the parts of men and are even transformed by degrees into men. We find composite monsters: a bull with a false beard, with a human face, with the arms and chest of a man.

THE link between the predynastic Sumerians and the still earlier Elamite civilization—about 4000 B.C.—is evident. The old Elamites never represented a god in human form, but they drew wonderful pictures of animals, especially of the wild species, and rather poor sketches of the human form. But the Sumero-Akkadians of the plain worshipped gods in human forms, with crowns, sceptres, and thrones like kings. They were no longer the hunting tribes of the Elamite hills, but they had regular institutions, city states, courts, and temples modeled on the courts. Between these two extremes, heroic hunting and regular court worship of the gods, there is a large intermediary layer of mythological figures which seems to connect them, and where we see the human god emerging from the beast while still in close contact with the primitive forces of nature.

The discovery of the predynastic cemetery at Ur has suddenly opened a door on a hitherto unknown stage of

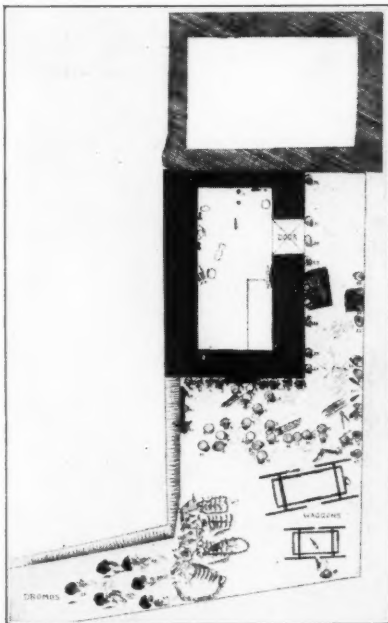
ancient human civilization, on the origin of Mesopotamian culture, perhaps on the ancestral home of the Sumerians. Nothing else so important has come of late out of the ground. It is time to satisfy our eyes and curiosity with a short inventory of the beautiful

material recovered in the tombs. We will select some of the best pieces.

The tomb of Queen Shub-ad produced a very great number of objects. There were two plain oval gold bowls, one with a wire handle, one fluted gold bowl, and a gold strainer. A pair of cockle shells in gold and another in silver were among her toilet utensils. Her name was found engraved on her lapis cylinder seal. There were also 18 silver tumblers, fluted and engraved, a silver jug, a silver bowl with a gold drinking-tube and another drinking-tube covered with lapis, many silver bowls and saucers, about 30 stone vessels and many in copper. With these was a very finely modeled bull's head in silver with shell plaques on the chest, which had probably decorated the front of a harp.

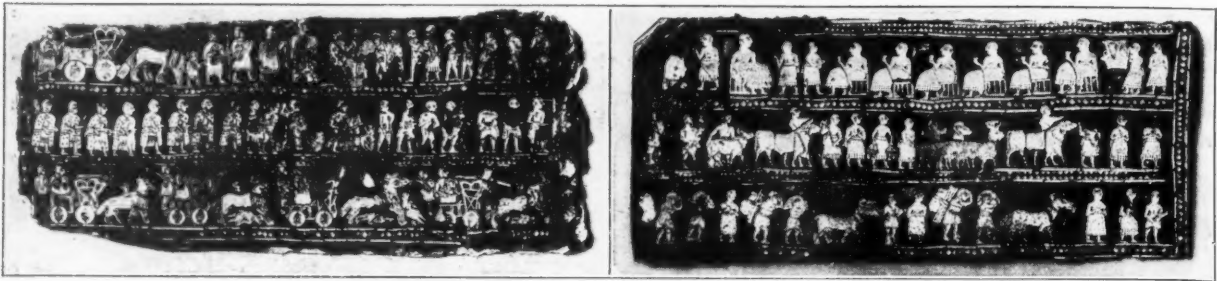
The body of the queen lay on a wooden bier, almost hidden beneath two silver lamps. Around the knees were garters of lapis and gold beads; on the hands were ten gold rings. The upper part of the body was entirely covered with a mass of beads in gold, lapis, cornelian, and agate, which had formed a beaded cloak fastened over the right shoulder and arm. The fastenings were composed of three large gold pins with lapis head, each attached to a big lapis seal. On the right arm were three fish amulets, one in lapis, two in gold, a gold amulet in the form of two seated antelopes, and one of a reclining calf made of lapis and hung on big beads of lapis and agate.

AROUND the neck was a "dog-collar" made of gold and lapis triangles. On the head was an elaborate headdress worn over an artificial wig. A broad gold ribbon passed several times round the head. A triple string of beads from which hung large gold rings ran across the forehead and above this were a second string of big mulberry leaf pendants of gold, and a third string of gold and lapis beads with small drop pendants, long slender willow leaves of gold in sets of three and gold flowers with inlaid petals of blue and white. From the back of the head rose a gold comb of Spanish form, like a pin broadening to



ROYAL GRAVE

Outside the tomb is the death pit, its dromos guarded by soldiers and chariots



WOODEN STELA INLAID WITH SHELL MOSAIC

At the left is shown the front of the stela, illustrating the war scenes. At the right are the peace scenes which are on the back

of this interesting record. The pictures follow a regular sequence of events. They are fully described in the text on the opposite page

a triangle having seven long thin points connected by wires and at the end of each point a large rosette with inlaid center.

By the side of the bier was a unique diadem. It is a fillet of thin leather to which were stitched minute beads of gold and lapis covering the whole surface; against this background were small gold rosettes, palmettes of thin twisted wire, branches in gold, with gold and carnelian pods, bunches of pomegranates with three fruits and three leaves, ears of corn in gold, and four pairs of seated gold animals, stags, rams, antelopes, and bearded bulls. It is a marvelous and delicate piece of work.

The earrings worn in the ears are spirals of gold wire. But in the hair under the gold ribbon headdress, there were enormous earrings in the shape of crescent moons, more than four inches in diameter.

The "death pit" around the tomb was littered with bodies. The ladies of the harem wore the identical headdress of gold ribbons, wreath of beads and mulberry leaf pendants, gold earrings, and a silver comb shaped like a hand with at the tip of every point a rosette having inlaid petals of gold, shell, and lapis.

AGAINST the side of the shaft were two bulls' heads, a part of harps otherwise entirely decayed; one is of copper, the other of gold and lapis with the hair, beard, eyes, and tips of the horns of lapis. This is a wonderful example of ancient Sumerian art. The head is hammered from a sheet of thin gold over a wooden core. The horns and ears are made separately and attached. Each tress of the beard is cut apart and set in bitumen on a wooden board inserted in a cut made below the chin. The inlay and polychromy of the materials are in the spirit of the old art. The result is very striking. The animal form is original and powerful.

The false beard is a mythological trait borrowed from an extinct race—the bearded bison of Elam, celebrated in the heroic story of the famous hunter,

Gilgamesh. His legend was sung to the tunes of the golden harp. Below the golden head were found four engraved plaques unrivaled for the energy and beauty of the drawing, and for the richness in mythological subjects. The first represents Gilgamesh, the famous king of Erech, the perfect athlete, nude except for a belt, and showing his superhuman force by grasping two human-headed bisons.

An extraordinary ritual scene is figured on the second panel. The butcher priest is an animal, a mastiff with belt and dagger—carrying a small

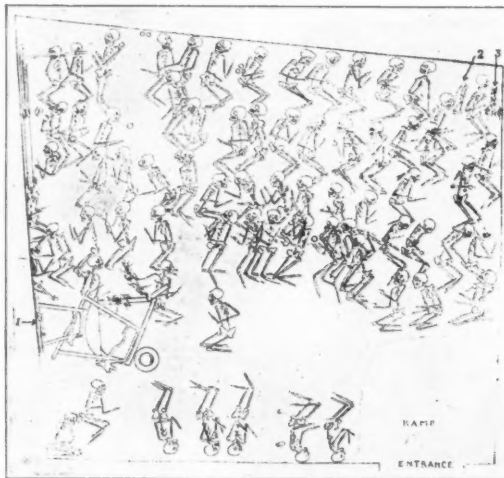
cymbals. Nothing so important to the study of Sumerian art and history has hitherto come out of the ground.

A gaming board, complete with its two sets of gaming pieces and dice was among other important finds. The shell plaques were engraved with animal scenes. One set of dice is of shell with lapis dots, the other of lapis with gold dots. A second very fine gaming board was found in a plundered tomb. All the shell squares are engraved with beautiful animal scenes, framed in blue lapis and mounted on silver. A complete board where the squares are decorated with geometrical designs was discovered the previous year and is now in the British Museum. Games and music were relaxations welcome to the souls of the dead rulers. A remarkable silver boat about 24 inches long found in the same tomb, complete with its oars and awning support, supplied the transportation across the dark waters of the kingdom of death.

IN the death pit around this plundered tomb of an unknown king were buried 58 persons. The ground was carpeted with matting. At the entrance, six soldiers were on guard, spears in hand, their heads still covered with copper helmets. At the foot of the ramp, two heavy four-wheeled chariots had been drawn up by their teams of three oxen. The bulls were harnessed

with reins made of large silver and lapis beads, silver rings were attached to their noses, and silver collars were around their necks. A mascot in the shape of a passant bull surmounted the rein-ring. Grooms and drivers lay dead along side their teams.

But the best was still to come out of a large plundered three-chamber tomb, one of the earliest yet found. The thieves had overlooked some good pieces—two imitations of ostrich eggshells, one in silver and one in gold (both had been encrusted with shell, lapis, and red stone), and a gaming board made of shell plaques framed in lapis and set in silver. But the most



PLAN OF DEATH PIT

Drawing showing relative position of objects. At 1 are the harps and at 2 and 3 are the statues of golden rams

table, a cane altar on which are piled choice pieces, a leg of lamb, a calf's head, and a bear's head. The dog has human hands. He is followed by a splendid lion rampant, carrying a lamp and a jar protected by a reed network like Italian *fiaschi*: the fire and wine of the sacrifice.

In the next panel a seated donkey plays on a harp upheld by a dancing bear; a seated jackal drums on a board and shakes a rattle: the music which always accompanies the ritual.

Finally, two mythological dancers complete the picture: a scorpion man and a rampant chamois, both with human arms and shaking rattles and

important object was a stela made of wood, 30 inches long. Both sides and the ends are covered with mosaics of shells cut and engraved and fixed on a background of lapis. Each side has three registers divided and bordered by a minute diamond pattern in white, red, and blue. It seems almost impossible to satisfy our curiosity by looking at the world of little figures crowded in the six registers and the two triangular ends. The front represents war scenes, and the back peace time. The king, the war lord, is a tall figure in the middle of the upper register. He carries a club and a lance. Prisoners are brought unto him headed by the chief of the defeated enemies. The king has alighted from his chariot and is followed by his officials. All wear copper helmets, lances, and axes. Their dress is a kilt with long laps, a plaid thrown over the left shoulder. All are shaven and shorn and barefooted.

THE chariot has four wheels, side and back panels, high front, and a curved pole supporting a rein-ring before its junction with the yoke. A groom, whip in hand, leads the team. The henchman follows on foot holding the reins and a battle-axe. The reins lie in a notch cut at the top of the front. A quiver full of darts and lances hangs at the left. A leopard skin is thrown over the back panel and the step on which stands the henchman during the action.

The team is four asses. Braids of hair are attached to their collars. The reins are tied to rings in the animals' noses. The wheels are made of two semi-circular pieces joined by copper clamps round a central core. The axle, solid with the wheels, turns in a groove below the body of the chariot. Copper pins secure the connection with the wheels. It is remarkable that

the wheel was used at Ur 1500 years before it was imported into Egypt. The wheel-band was probably made of bronze sections.

The second register shows the infantry in action, the third the chariot-eers. The legion has formed a solid rear line. All wear scalloped kilt, helmet, and mantle, and they have lowered their lances. The front line is engaged. The enemies are prostrate, wounded, stripped, bound, captive, or in flight. The bodies of the enemies are nude and cut by wounds. The charioteer scene is a pure delight. It begins with a lively pace and finishes in a mad charge.

The peace scene is not less interesting. The king is seated with his sons or officials and drinks a cup of the best, while a harp player and a singer recite the great deeds of the battle. Below, a pageant of servants bring the requisites of the feast: bulls, goats, ram, lamb, and four big carp. The procession is closed by teams of asses with their drivers and pack carriers. To the victor belong the spoils. This memorial or standard is an unparalleled work of art, an invaluable historic document.

THE last campaign, which ended at the beginning of February, has revealed new tombs, shafts, and death pits. One domed chamber was found intact. The clearing of another death pit has given astonishing results. In a space of about 25 feet square were piled the remains of 74 persons, most of them women. Many of them wore the well known court ornament of Queen Shub-ad: gold ribbons and wreaths of gold leaves, beads of gold and lapis and carnelian, and tall Spanish combs spreading into flowers with inlaid petals. What a strange and impressive show when the warm bodies were laid on the carpeted soil, dressed in their purple mantles and golden crowns. Perhaps they were the votaries attached to the court of the high priestess, herself a sister or daughter of the king.

In one place four harps were piled together. Their sounding boxes were decorated with inlay. Mosaic work and gold bands covered the uprights. The largest had its top beam made of silver and had in front a magnificent gold head of a bearded bull. The beard attached by a string and flowing in large wavy curls below, suggests the majesty of the famous Moses of Michelangelo. Below this head are the usual engraved plaques, the lines of the design being filled with red and black in sharp relief on the white ground. The second harp is of silver and is decorated with a silver head of a bull without beard, perhaps a cow. The box suggests the form of a crouching animal bellowing in pasture land when the eve is cool. The third harp

is boat-shaped and is decorated with a statue of a stag standing amidst branches. The whole is of silver. Another copper statue of a stag belongs to a harp which has entirely perished.

In another corner of the pit, two statues of rams in the round are not less remarkable. They are master-

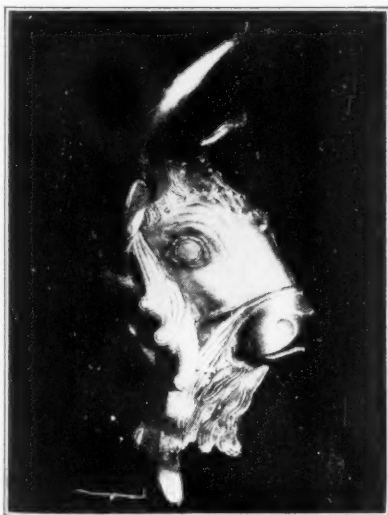


SILVER HARP

This boat-shaped harp is decorated with a statue of a stag. The whole is of silver.

pieces which instinctively recall the works of Benvenuto Cellini. Two rams of gold, silver, lapis, and shell pieces cut to imitate the fleece, are represented standing on their hind legs, their front legs caught among branches and flowers of a shrub made of gold, silver, and inlaid stones. The two sockets on the upper part of the statues suggest that they were used for support of what we could fancy were wax candles at a royal feast, if such profanities were not a little frivolous while talking of the grim old Sumerian antiquity.

AND why not after all? The newly revealed civilization has many points by which it appeals to the modern mind and seems close to us. The same human delight in beautiful things and forms; the same pleasure in glittering gold and silver and luscious white shell; the same craving for ornaments, gold, lapis, carnelian beads, gold crowns, earrings, necklaces. The same time-honored crafts of the smiths and jewelers; the same refinements of songs and music; the same relaxation of dice and gaming boards; the same passion for war and hunting and driving in state over the plain. But we stop and feel strangely impressed by their creed and belief of life beyond death, and we are distressed by the murder of so many human victims. But is not life arising from death and are such beliefs so far from many modern creeds that life is not worth while without sacrifice? The history of religions and of anthropology has much to learn from the predynastic cemetery of Ur.



HARP DECORATION

This golden bull's head ornamented one of three harps discovered recently at Ur

Electric Thermometers for the Stars

The Eye Is No Judge of the Heat which Each Star Radiates, but a Thermo-Couple Measures It with Precision.

The Hotter a Star the Greater the Proportion of Its Radiation We Perceive Visually, but the Very Hottest Stars Radiate Mainly in the Ultra-Violet

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

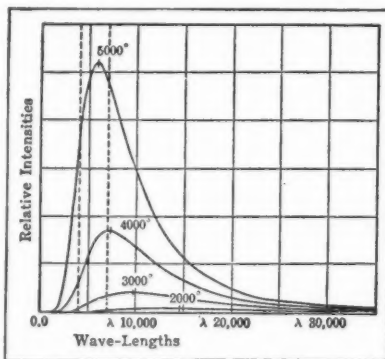
"COLD as the north side of a January gravestone by starlight" is a phrase which recalls the extravagances of Yankee humor rather than the truths of science, yet a real if familiar physical fact is recalled by the words. The stars send us no perceptible warmth. Indeed the starry night is often a cold one because the clear air allows heat to escape from the earth's surface into space, while nothing comes back from its depths to redress the balance. Yet when we substitute the delicate equipment of the modern laboratory for our comparatively insensitive skin we find that even the far-off stars do send us heat, although very little of it.

TO detect the existence of this heat radiation was a few years ago a *tour de force*. Today it can be measured with precision; not merely for the brighter stars, but for stars invisible to the unaided eye. Pettit and Nicholson, who have been working for a long time upon this problem at Mount Wilson, have recently published the results of a five years' campaign. Something has been told of the work in these columns before, but there is much more to tell now, and much that is of great interest.

Needless to say, the great 100-inch telescope has been used to concentrate the greatest possible amount of starlight, but even this would be of no avail if the receiving apparatus were not of almost incredible sensitiveness. After many trials—in both of the familiar senses of the word—the electrical heat measuring system has been perfected. The star's rays, passing through a transparent window into an exhausted receiver, fall upon a tiny thermo-couple—the junction of two wires of different alloys. If this is heated an electric current is set flowing, which passes through a delicate galvanometer.

The wires which are actually employed are hardly more than a thou-

sandth of an inch in diameter. The whole thermo-couple, with two junctions so arranged that shifting the star's image from one to the other reverses the current and doubles the effect, weighs less than one 600th of a grain, and the part which is heated at any one time by the star's radiation weighs only one 2000th of a grain. The heat from Betelgeuse, which sends us more than any other star, even when concentrated by the great mirror upon this tiny speck, raises its temperature by less than one 60th of a de-



From Russell, Dugan and Stewart's "Astronomy." Courtesy Ginn and Co.

HOW MAXIMUM RADIATION SHIFTS

This diagram shows how maximum intensities of radiation shift toward the ultra-violet as temperature rises. The two vertical, dotted lines delimit the visible spectrum. As Dr. Russell explains, a curve for 20,000 degrees would have a maximum still farther to the left, in the ultra-violet, but our atmosphere would cut off most of this short radiation

gree. This sets up a current of only one 7,000,000th part of an ampere in the circuit, but so sensitive is the galvanometer that the recording spot of light swings through 18 inches! With this perfected equipment, radiation which sufficed to heat the receiver by less than one 100,000th part of a degree has been measured, and any star which can be seen with the naked eye is within the reach of the apparatus.

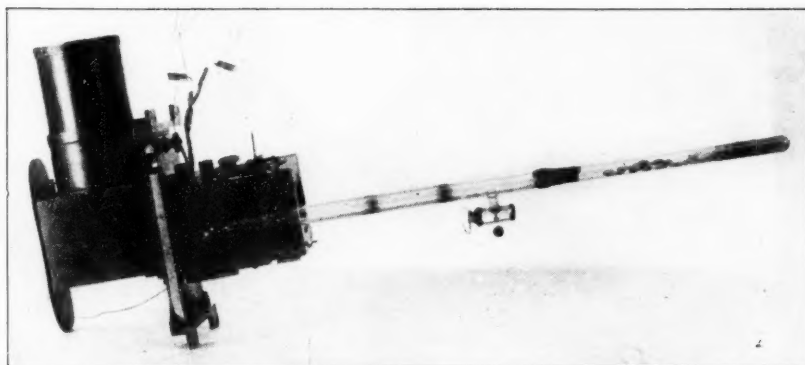
More than a hundred stars (124 to be exact), including some of almost every known variety, have thus been measured and the results are of manifold interest. Perhaps the most striking of these results is the great difference in the amounts of heat which we receive from stars which to the eye appear of the same brightness. If we could see heat, that is, if our eyes were equally sensitive to radiation of all wavelengths instead of being confined to one narrow band, Betelgeuse would rank as the brightest star in the sky, since it sends us again as much heat as Sirius. Antares, too, would appear a little brighter than Sirius, although to our eyes, as they are, it looks only one twelfth as bright. Canopus would come fourth in the list; then Gamma Crucis; Arcturus; Alpha Herculis; Aldebaran; and, at its maximum, the variable star Mira.

ONE who is familiar with the stars will notice at once that most of the stars upon this list are red—and here we come upon the most conspicuous peculiarity revealed by the heat measurements: the white and yellowish white stars such as Procyon, Canopus, Sirius, Rigel, and even the bluish stars of Orion's belt, send us heat nearly in proportion to their light. When we come to the yellowish stars like the Sun or Capella we get 50 percent more heat for the same amount of light. A star like Arcturus (class K) sends us more than twice as much heat as a white star of the same brightness; a red star like Antares six times as much; and from Alpha Herculis, which is very red, we receive 50 times as much heat as from a white star that looks equally bright to the eye. It is, however, the total heat and not the light that comes from the stars, that is obviously the more fundamental quantity. So we will do better, then, to reverse our statement and say that the white and yellowish stars all send us about the same amount of light in

proportion to their heat; the Sun two thirds as much; Antares about 15 percent; and Alpha Herculis only 2 percent. When put in this way we recognize that the differences have to do with what the illuminating engineer calls "luminous efficiency," and the every-day purchaser of electric lamps knows as "candles per watt."

Our familiar lighting devices are far from ideal. An incandescent lamp, indeed is a pretty efficient apparatus for turning electrical energy into heat—as those of us know to our cost who have left a lighted bulb too near to combustible material. This heat has come from the hot filament, through the vacuum to the wall, and hence by radiation. But only a smallish fraction of it was carried by the short waves which affect our eye, the rest being borne by longer, invisible waves. The higher the temperature of the source the greater the fraction of the whole energy carried by the short light waves. Hence, the history of progress in electric lighting has been largely one of development of refractory materials which could be run at a high temperature without wearing out.

AMONG the stars exactly the same principle is in evidence. The very same equations which enable an illuminating engineer to calculate how much gain in efficiency he will get by the use of a filament that can be run at a higher temperature, permit the astronomer to calculate from the observed relation between the light and heat emitted by a star, how hot its surface may be. These calculations



THERMO-COUPLE FOR DELICATE RADIATION MEASUREMENTS

This is not the apparatus used by Pettit and Nicholson, but a similar piece devised and used by Dr. W. W. Coblentz of the Bureau of Standards, in research on planetary temperatures

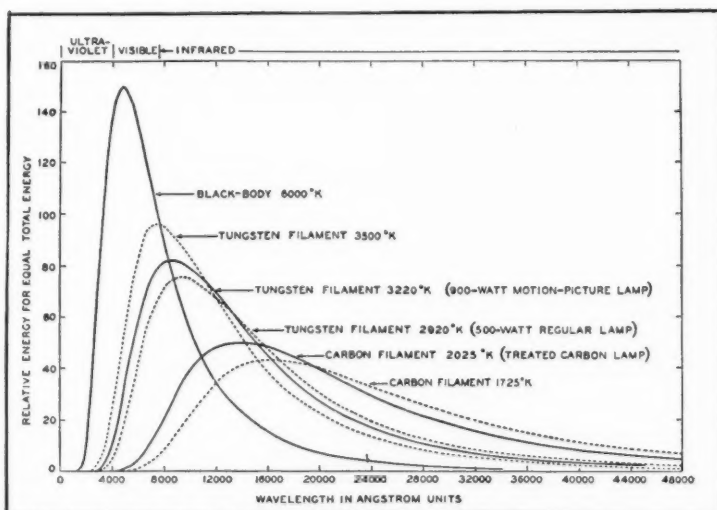
confirm the conclusions which have already been drawn from the color of starlight, and show that the scale of stellar temperatures begins about where that of laboratory temperatures leaves off.

A very red and cool star like Alpha Herculis has a surface temperature of about 2300 degrees, Centigrade; while a moderately red one like Betelgeuse is at 2800 degrees, which is not far from the highest temperature attainable with most electric furnaces. As the temperature rises higher the proportion of the energy which is radiated within the limits of the visible spectrum rapidly increases, until at about 6000 degrees the region of strongest radiation from the stars' surface coincides with that in which the radiations affect our eyes most powerfully.

Here we might expect the luminous

efficiency to be a maximum, since for still hotter stars an increasing fraction of the radiant energy moves over into the ultra-violet—waves too short for the eye to see. If we could observe from a station on the moon there is no doubt that we would find this to be the case, but our terrestrial measures have to be made through miles and miles of air which is quite opaque to ultra-violet light only a little beyond the limit to which the eye can see. Hence, the short-wave radiation fails to reach our instruments, as well as to stimulate our optic nerves, and the falling off in the ratio of light to observable heat, although present, is small.

Theory once more comes to our aid and shows how much more heat we would receive if we could get outside the atmosphere. The difference is least for a star of about 4500 degrees temperature, for which 70 percent of the heat gets through the atmosphere. For cooler stars the difference is not great, the transmission being 50 percent for a temperature of 1900 degrees. But if the star's temperature is 10,000 degrees, only 40 percent of its heat gets through; at 15,000 degrees the transmission is 21 percent, and at 20,000 degrees only 11 percent. The stars of Orion's belt are probably at least as hot as this; hence if we could measure their radiation without interference we would doubtless get almost ten times as large a reading as we actually do.



Courtesy of the Journal of the Franklin Institute

GETTING MORE "CANDLES PER WATT"

Compare with diagram opposite. In both, an increase in temperature shifts the maximum of radiation toward shorter wavelengths (Wien's law of displacement). This explains why tungsten filaments, which will withstand higher temperatures, give more candles per watt than carbon filaments. A perfect radiator ("black body") would be still more efficient (see curve) if it could be heated to 6000°K or "absolute" (5727°Centigrade) without melting. The diagram above was originally published by Dr. M. Luckiesh, to prove that the most penetrative source of infra-red therapeutic rays is a tungsten filament lamp, our bodies being virtually opaque to waves longer than 14,000 Angstrom units; but it serves equally well to illustrate Dr. Russell's point about shifting maximum radiation

APPLYING this correction we could find at last, when we know the distance of a star, how much heat it sends out into space. This, of course, is the real measure of the star's greatness and it is interesting to note that, judged by this criterion, the greatest known stars are much alike, whatever their surface temperature. Among the long list given by Pettit and Nicholson the outstanding stars are Alpha Herculis, with a surface temperature of 2300 degrees; Antares (2700); Alpha Cygni (10,000); Rigel (13,000); and Epsilon Orionis (12,000)—the brightest in Orion's belt.



Courtesy North Dakota College of Agriculture

FIRES DOT THE PRAIRIES AFTER THE HARVEST

America produces about 48,000,000 tons of grain a year; consequently there are about 96,000,000 tons of straw. Much of this is burned, although it has high commercial value

Farm-waste Profits: Best Farm Relief

Utilization of Waste Is Seen As the Surest Hope of the Farmer

By ROBERT STEWART, Ph.D.

Dean of the College of Agriculture, University of Nevada

THE farms of America are producing more food than our people can consume and the surplus production of farm products has created a vital problem which is pressing for solution. Attempts are being made to solve this problem by political action and its solution was a dominant political issue in the last presidential election. Whether or not any real help will be afforded farmers by government action, however, has yet to be decided.

The capacity of the human stomach also is limited and the changing dietary habits of the people are actually causing a decrease in the consumption of our common foods. The demand for our agricultural products in foreign lands is markedly limited by the ability of these people to buy in any large quantity. New markets for agricultural products as food cannot be created and there is no solution for the farm problem in that direction.

Controlled production of farm products is far more difficult than the control of production in industry and is probably not feasible because of the large number of farmers concerned and their unorganized state.

There is one important way in which relief for this situation may be obtained for the farmer and that is in the development of new uses for farm products. The corn plant consists of leaves, tassels, silk, roots, cobs, and grain. The grain alone is regarded

as of value and that only for livestock. The remainder largely goes to waste. The feeding of seven eighths of the grain to livestock is an extremely wasteful process, as wasteful as burning coal in a furnace to produce heat. The grain of corn consists of definite organic chemical compounds which have great commercial value. It contains cellulose, starch, sugar, protein, and oil. The farmer is therefore a producer of organic chemical compounds. He now produces food for human consumption: he must produce raw materials for industry and thus feed factories as well as human stomachs.

ON the hundred million acres of corn land in America, 200,000,000 tons of cornstalks are produced. These stalks will yield over 30 percent of high-grade cellulose of high purity capable of being converted into the best artificial silk and motion picture films. Paper and lumber substitutes also can be made from the stalks. At Danville, Illinois, cellulose for films and rayon for cloth is now being produced commercially from cornstalks. Celotex, a lumber substitute, is produced from the fiber of sugar cane, a farm waste product, and one company has been organized in Iowa to produce wallboard from cornstalks.

There are also produced 20,000,000 tons of corncobs which now largely go to waste. On being submitted to destructive distillation, however, they

yield an adhesive material suitable for briquetting, and furfural which has innumerable uses. In the presence of air, furfural readily darkens and resinifies, thus producing material of value in the making of phonograph records, pipe-stems, and radio loud speakers. It is an antiseptic similar in nature to carbolic acid. It is, therefore, of great value as a germicide and as a fungicide. It penetrates wood very readily and is of value in dressing the wounds on valuable trees. It is also used to flavor tobacco. Owing to its solvent action and high power of penetration and low toxicity it is used as a solvent for dyes and leather dressings. It is an excellent solvent for nitro-cellulose and finds use in the lacquer industry. It is an excellent fly repellent and is used for this purpose with marked success. This important product may easily be prepared from corncobs. The corncobs and cornstalks make up three fourths of the farmer's corn crop and thus constitute valuable by-products.

The grain of the corn also contains valuable organic chemical compounds. The germ of the corn kernel contains a valuable cooking oil and also paragol, a rubber substitute of value for making bath sponges. The germ from a bushel of corn will yield a pound of oil in addition to a certain quantity of the paragol. The residue of the germ is still valuable as cattle feed.

THE hull of the corn kernel yields phytin, a food of great value to people suffering from nervous disorders as it contains 21 percent of assimilative organic phosphorus. The hulls from a bushel of corn still provide 14½ pounds per bushel of protein valuable as a tissue builder for livestock. The endosperm of the corn kernel contains starch. A bushel of corn will yield 33 pounds of laundry starch. Or the starch may be converted into dextrose or corn sugar which has a wide and growing use in bread making, ice cream manufacture, and the preserving of fruit.

Over half a million pounds of corn sugar are being used in the baking industry per day and its use is constantly growing. A bushel of corn will yield 25 pounds of corn sugar and, in addition, 15 pounds of corn syrup. At the present time we are importing 58.7 percent of our requirements for sugar from foreign sources and paying 360,000,000 dollars annually for it. The greater use and development of our corn-sugar industry will retain much of this money at home. The corn may also be converted into solvents for use in the automobile, motion picture, and other industries, for the production of films, lacquers, artificial silk, leather, dyes, and numerous other common compounds. A bushel of corn will yield 11 pounds of solvents consisting of 60 percent normal butyl alcohol, 30 per-

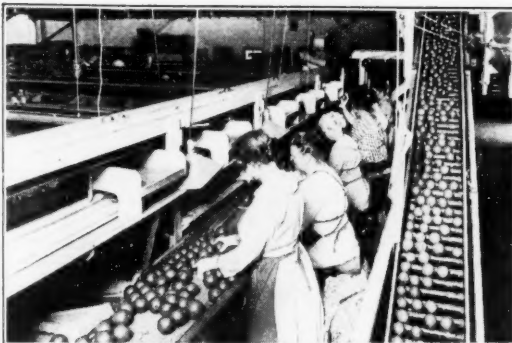
cent acetone and 10 percent ethyl alcohol. Two factories, one at Terre Haute and one at Peoria, are conserving 30,000 bushels of corn daily—10,950,000 bushels per year—for the production of these solvents. The residue contains all the protein and most of the other essential food elements and is of value as live-stock feed.

There are 25,000,000 dairy cows in America and they produce 2,500,000,000 pounds of butter per year. For every pound of butter produced there are two pounds of other solids in the milk, most of which now goes to waste. These solids can be utilized in industry and, in a few notable instances, marked success has been achieved in their utilization. The casein in these milk solids is used to make imitation ivory which finds an abundant use in the manufacture of toilet articles such as combs and hair brushes and various other attractive articles for milady's boudoir.

THE casein is also used as sizing for various types of material including the production of the sheen on paper. In 1926 over 78,000,000 pounds of milk solids were recovered from the milk and marketed successfully. The recovered dry skim-milk offers an excellent means of overcoming the common deficiency in the diet of the average American family by providing the lime and phosphates so essential to health and too often lacking in our more common foods. There is a ready and growing market for this waste product of the farm.

On the grain fields of America there are produced about 48,000,000 tons of grain each year consisting of wheat, oats, and barley. The grain is used largely as human food, live-stock feed, and in industry. For every ton of grain produced there are approximately two tons of straw produced which now largely goes to waste. If the straw is not actually destroyed by fire, it is used as roughage for feeding live stock and as such has only very indifferent value. This waste material is a valuable source of many important organic compounds of value in industry. It contains cellulose of high purity. It contains lignin, a compound which probably has as important a use in industry as does coal tar, the base of all our important dyestuffs.

It has long been known that an abundance of gas may be obtained from wheat straw and various attempts have been made to use it industrially. When straw is submitted to destructive distillation, that is, distillation in the absence of air, various important products are obtained. When



Courtesy California Fruit Growers' Exchange

THROWING OUT THE CULLS

Citrus fruit culls—poorly colored, small lemons, et cetera—are now being fully utilized

straw is burned in the open air, about 40 pounds of ash per ton of straw is all that remains. When straw is submitted to destructive distillation, about 1600 pounds of valuable organic chemicals per ton are recovered, including disinfectants, fly spray, straw oil, roofing and damp proof material, straw carbon, paints, and auto top dressing.

At St. Joseph, Missouri, a modern pulp and board mill has been erected for the purpose of manufacturing insulating board from wheat straw. It is claimed that the long, tough, cellular fibers in wheat excel all other fibers for the production of insulating material of great strength.

THERE is abundant demand for insulating material of this type in the construction of houses, refrigerators, and other devices when resistance to heat and cold are required. Paper board from wheat straw has great structural strength, is virtually fire resistant, and is unexcelled for its sound-deadening qualities.

When the straw is used more generally for these purposes it will bring in as much to the farmer as he now receives for his grain alone. The farmer's profits will be materially increased and the useful commodities obtained from the straw will contribute to the sum total of human happiness.



200,000,000 TONS

That quantity of cornstalks are produced yearly in America. From them can be made many products

Cotton seed was once an offensive waste product in the ginning of cotton. It was necessary in many communities to pass laws governing the disposal of this waste product as a measure of health protection. Cotton-seed oil is now extracted from it and the toxic principals removed so that now cotton-seed meal is a valuable cattle feed. This former waste product is now valuable and adds from 10 to 20 dollars to the price the farmer receives for a bale of cotton. The cash value of this waste product

of the farm in 1926 was 154,000,000 dollars! Chemists have found that cotton-seed bran, as well as peanut hulls, can be converted into an acid which is cheaper than lactic or tartaric acid and can be used for soft drinks, candies, and in tanning leather. The bran is sometimes used as cattle feed, but many tons of bran and peanut hulls are wasted yearly.

The California Citrus Exchange has erected a factory at Corona, California, for the disposal of surplus lemons which are utilized by being converted into citric acid, pectin, and lemon oil. The poor quality citrus fruits are thus removed from the market and the growers' profits increased by the creation of a demand for quality products as well as by utilization of unsalable fruit. The packing house industry boasts that in the conversion of the hog into bacon everything is utilized except the squeal. The citrus industry does better than this: they utilize everything from the orange, including the oil which produces the flavor!

In the raisin industry in California the unsalable raisins, stems, and seeds are used to produce fruit sugar sirup which finds a ready sale. Surplus grapes by the trainload are converted into industrial alcohol.

THE industrial utilization of farm crops is only in its infancy. The farmer, by the aid of soil, sunlight, moisture, and plant food, is a manufacturer of definite organic compounds through the growth of plants. He produces cellulose, oil, sugar, protein, and starch, and will in the future furnish more and more of these raw materials to the factory where they will be fermented, distilled, and hydrolized into a variety of materials which will find a ready market in the usual channels of trade. As this method of utilization of farm products slowly develops so will the problem of the farm surplus slowly disappear and the farmers of America will become contented and prosperous as the workers in industrial lines now are.



NAVAL AEROLOGISTS WILL AID MILITARY AND CIVIL AVIATION

A close-up view of strato-cumulus clouds which indicate direction and speed of air currents. Aerologists are studying all that is known concerning the relation of clouds to the weather

Naval Aerologists

Weather Predictors, Naval By-products, Are Trained in Intensive New Course

By CAPTAIN W. D. PULESTON, U. S. N.

IT is well known to SCIENTIFIC AMERICAN readers that the country receives many indirect benefits from the money spent on the navy in addition to the ever-present protection for which the navy is primarily organized and maintained. But probably only a few are aware of one of the latest naval enterprises which, when consummated, will confer a lasting benefit on the whole country.

Events of the World War demonstrated anew the profound influence weather has on the operations of war on land and sea. The increasing use of aircraft, both heavier and lighter than air, in our navy since the war, has made it increasingly desirable to obtain accurate forecasts of the weather. The United States Weather Bureau has for many years furnished forecasts for the land areas of the United States, and more recently has increased its service to include predictions for the shipping using United States ports, particularly reporting the development and progress of West Indian hurricanes. The Hydrographic Office has, since the middle of the last century, issued its pilot charts giving average weather conditions over all the oceans.

But neither of these splendid institutions could furnish the forecasts needed by the United States fleet which includes air, surface, and sub-surface craft, and which must be prepared to

operate in any part of the world. Manifestly, therefore, the navy must have its own aerologists to accompany the fleet, and as there were scarcely any aerologists available for this duty in the United States, the Navy Department was compelled to commence training some for its own service.

Accordingly, in 1926, the Secretary of the Navy directed the Bureau of Navigation to select from the junior officers of the navy, eight volunteers of suitable qualifications to prepare themselves for this new scientific endeavor. From a large number of applicants, eight ensigns or junior lieutenants were chosen who had, while midshipmen at the Naval Academy, shown an unusual aptitude for mathematics, thermodynamics, and the physical sciences.

WHILE the students were being selected, a board of officers began to prepare the course. This proved more difficult than selecting the students. No university or technical institute in the country offered exactly the course that was needed. One university offered an excellent course in meteorology, a professor in another university was the outstanding American authority on cloud forms, one of the world's foremost experts on oceanography was in our own Hydrographic Office, the most experienced of our

practical American forecasters were in the Weather Bureau, a German was the acknowledged master of the dynamics of meteorology, the Smithsonian Institute possessed the leading authority on the effects of solar radiation on the weather, and in Sweden resided a scientist who had devoted his life to studying the effects of the polar regions on the world's weather.

It was necessary to familiarize our students with the works of all these authorities in order to furnish them a comprehensive course in aerology, and the board would have soon despaired of its task except for the enthusiastic support it received from all the many scientists interested in the study of weather.

Two universities and a technical institute offered to provide a specially designed course, separately or jointly; the Weather Bureau, the Smithsonian Institute, and the Hydrographic Office put their resources at the disposal of the board; every weather authority consulted, gave his time freely and abundantly to the board and offered to assist in a lecture course to the class. In a short time the board was able to concentrate on this new undertaking many of the scientific minds of America devoted to the study of weather.

THE two-year course which commenced in 1926, was as follows:

FIRST YEAR:

(a) Academic Term: (Eight months)

Regular postgraduate course at Naval Academy, emphasizing mathematics (differential and integral calculus, differential equations), aerodynamics, thermodynamics (textbooks by Buckingham and Birtwistle), meteorology (Milham), forecasting weather (Shaw), preliminary studies in physics of the air (Humphreys), and aerology (Aviation Training School Manual).

(b) Summer Term: (Three months)

Instruction in weather maps—Bureau of Aeronautics, Forecasting practice—Bureau of Aeronautics and Weather Bureau, Oceanography—Hydrographic Office, Instruments—Naval Observatory and Weather Bureau.

SECOND YEAR:

(a) Academic Term: (Eight months)

"Physics of the Air," Humphreys; "Dynamische Meteorologie," Exner; "Aeronautical Meteorology," Gregg; "Clouds," Clarke; "Cloud Studies," Clayden; Survey of the works of Bjerknes (Bergen Geophysical Institute); in addition, daily practice in map drawing and forecasting.

(b) Summer Term: (Three months)

Study of naval aerological problems and aerological practice at naval air stations, Lakehurst or Pensacola, including forecasting practice.

The first class of eight officers completed this course last fall and have

already been detailed to various vessels of the fleet to commence forecasting the weather. It is inevitable that these pioneer predictors will make some mistakes in their forecasts, and they will often be bantered by waggish messmates, and occasionally upbraided by an indignant Admiral misled by an erroneous forecast, but it is also safe to predict that these scientifically trained minds, resolutely undertaking a problem unsolved at present, will at least stumble forward and eventually either they or their successors will completely unravel the complicated laws of weather, and develop a system that will provide an accurate forecast of the weather.

THE second class began its second year's work at the Massachusetts Institute of Technology last fall, where a special course modeled after the one previously described, was arranged for them through the keen interest of the president of that institution. The Guggenheim Foundation immediately recognized the value of the course to the future of aviation, and has endowed a chair at the Institute of Technology, thus making the course available to civilian students. The army was quick to realize the advantages of the course, and is also sending students to the class.

Thus in order to satisfy the needs of the navy, a course of study in weather forecasting has been established that will undoubtedly be beneficial to the country at large. It may be added that it was undertaken none too soon for our country's credit. In England, Germany, and Sweden, such courses are already available and consequently they have gained on us in knowledge of weather.

Enough is already known of weather prediction to realize that more numerous and complete reports on conditions affecting the weather are required before much further progress can be made. For instance, comparatively few reports



SAN DIEGO CLOUDS

Typical May day strato-cumulus clouds over the California city, near the coast

are obtained of conditions over the Pacific Ocean, yet the weather on our west coast is immediately affected by these comparatively unknown conditions. Nor is it sufficient to know the conditions at the surface of the earth. The upper air strata must be explored. Fortunately the Navy Department is able to assist in obtaining data over the ocean by its own vessels, and by observers on merchant ships, who since the middle of the last century, have assisted the Hydrographic Office and the Weather Bureau to collect the data on which its current and pilot charts are based.

These marine observers, once they are trained and supplied with the necessary instruments, will be able to supply additional data to predict the weather actually brewing while it is in the making. The Hydrographic Office has already begun to enroll its marine observers in the new undertaking. The various air stations of the government, and many of the existing Weather Bu-

reau stations are prepared to take air soundings to obtain data on the condition of the upper air currents.

It is planned first to equip men-of-war so they can obtain data of upper air currents, and then gradually to equip especially selected merchant vessels so that American predictors can anticipate, in the near future, receiving greatly increased data upon which to base their forecasts. Practically all merchant vessels are now equipped with radio, and certain naval radio stations have already assigned special schedules to receive and broadcast reports from observers in waters surrounding our country, so there will be small delay in collecting and disseminating weather data.

RADIO not only furnishes the means of forwarding weather data, but radio static has already been used as an auxiliary means to locate and follow a "disturbance," or area of low barometric pressure as an embryonic cyclone or hurricane is called before it matures. Radio static has not been observed to accompany all disturbances, so it is not an infallible indication of a storm.

The ideal information system which the Navy Department and Weather Bureau have in view will eventually provide a continuous flow of information of the conditions at the surface and in the upper air strata over the land and water regions adjacent to our own coasts, in addition to the information of conditions in the interior of our country.

With this comprehensive information continually received, our carefully trained predictors will immediately be able to increase greatly the accuracy of weather predictions, gradually add to our knowledge of weather, and eventually reveal completely one of nature's last and most carefully guarded secrets, the laws of weather.



CLOUD FORMS FURNISH IMPORTANT CLUES TO WEATHER PREDICTORS

Excellent examples of strato-cumulus clouds changing to cumulonimbus, taken at the Lakehurst Naval Air Station. The one at the

left shows the ragged edges of the clouds and the characteristic turbulence. Airship shed in foreground. At the right; a different view

The New Outlook In Physics*

"We Have, Indeed, Far to Go: We Have as Yet But Scratched the Surface of Things"

By SIR OLIVER LODGE

IN a recent address on "Literary Biography," Mr. Philip Guedalla has wittily said that "Biography is a thing with perfectly definite limits; it is a region that is bounded on the north by history, on the south by fiction, on the east by obituary notices, and on the west by tedium." We may parody this by saying that the science of physics is bounded on the north by mathematics, on the south by experiment, on the west by accumulated experience of the past, and on the east by intuition and speculation.

The northern region is cold and arid, but exceedingly bracing and stimulating to those who have sufficient clothing to enable them to feel at home in those icy fastnesses, whence descend fertilizing streams to the plains below. The southern region is more habitable, and very fertile in all manner of practical contrivances which have modified, complicated, and to some extent ameliorated, the lot of mankind: so that it leads into a region of tropical fruitfulness in which the engineer and the capitalist are more at home than the pure physicist. The western boundary is one towards which our luminaries appear to be continually descending into comparative oblivion, leaving behind their fructifying influence, and becoming themselves more or less superseded and out of date.

It is to the eastern horizon now that all eyes are turned, watching the luminaries that are ascending through the mists of the morning, only dimly seen as yet, but bringing with them a great promise for the future and hopes of a clearer sky when the clouds have cleared away.

THE electron was one of the objects on which our scientific observer feasted his eyes, at the beginning of this century, as a definite speck of brightness. But now it is drawing itself out, and seems more like a comet than a fixed star. Its boundaries have become blurred, and its locality indefinite. From one point of view the definite points of light seem merging into a sort of continuum; while, from another, a continuous luminosity gathers itself together into discontinuous points. The gain of definiteness on the one hand is mingled with a loss of definiteness on the other. A continuum seems breaking up into discontinuities, and

yet discontinuities show signs of merging into a continuum. It is impossible to say what the outcome will be, and it would be rash to make the attempt. Suffice it to say that a greater unity is beginning to be discerned throughout the material cosmos; and that the initial stages of some comprehensive unification are of great interest for the present and of good hope for the future.

Let us now trace these unifying resemblances rather more in detail.

The atom has yielded up some of its secrets; and so have the stars. The two things, so different in scale, are more alike than had been expected, and investigation of the one helps our knowledge of the other. It is probably true that more is known about the interior of a star than about the interior of the earth. Some of the stars are disintegrating into radiation, and so are some of the atoms. Nothing material is permanent, everything is in a state of flux; as indeed was said long ago by Heraclitus as a brilliant intuition. But it is turning out more literally true than could have been anticipated. Old-established laws are modified and half discarded, new laws take their place, and we are surrounded by uncertainty. The conservation of matter has had to be discarded, and there are signs that even the conservation of energy begins incredibly to be suspect.

MEANWHILE, matter and energy have merged into one another; both are treated geometrically as if they were properties of space, or rather of the greater generalization called space-time; and there is beginning a great unification which, in spite of present complexity, seems likely to lead to an ultimate simplification. Electricity and magnetism, whatever they may be ultimately resolved into, seem likely for the present to reign supreme. Already they have dominated and annexed the domain of optics and light; they are depended on for cohesion; and now they seem likely to absorb gravitation likewise. Matter already is largely electrical, some think wholly electrical. It has been discovered to be one of the forms which energy may take.

The whole of activity consists in the transmutation of forms of energy; although what energy is in itself remains an open question. Space is discovered to have physical properties: and just

as Faraday recalled our attention from the conductors supporting electric charge to the space surrounding them, and showed that all the observed phenomena really went on in that apparently empty space, so it would appear to be with our wider outlook in the near future. Matter is turning out to be an insignificant portion of the whole physical universe, a rare and occasional perturbation of its vast extent; and probably the more important, although certainly the more elusive, activities occur in the interatomic, inter-planetary, and interstellar space.

HITHERTO our attention has been concentrated and almost entirely limited by our senses to the particles and aggregates of matter. But now our minds are ascending beyond the scope of sensation into the fundamental region in which matter exists. All the heavenly bodies move in a vacuum; and so does every atom. It is in the interspace that the energy really lies. Something in space it is which welds particles together by cohesion into a tangible body, and welds bodies together by gravitation into a cosmos; so that the properties of that interstitial space are likely to form the greater part of the physics of the future.

We know something about empty space already; we know that it can transmit radiation, and we know the rate at which radiation travels. There seems no doubt about that, although the intimate or ultimate nature of radiation we do not yet know. We realize that it is a modification of space, and we can follow the modification in time. But what unmodified space is like, and what time is like, we do not know. We can, however, experiment on radiation by aid of its interaction with matter.

Another modification of vacuous space we call an electric charge, and we can make experiments on that too. Surprisingly it has inertia, and is amenable to mechanical force. It almost certainly has weight. Another variety of obscure energy we call a magnetic field. These are all modifications of space; and probably the very ingredients of the atom of matter are modifications too, for the atom is composed of positive and negative electric charges, far apart from each other in proportion to their size. Herein enters the possi-

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bility of experiment. We can apprehend and deal with matter; for it is an immediate inference from our tactile sensations, and we are provided with muscles which enable us to move it—to move it in accordance with plan. We might define matter as that which can be moved; although what “motion” really means we should find it difficult to explain. Matter and motion are things we have senses for, so that we have grown accustomed to them, and are apt to forget their mysterious nature. The problem of modern physics is to try to understand these over-familiar things and to resolve them into something more ultimate, although at the moment less intelligible. Not unnaturally our early attempts at formulation involve unfamiliar and even contradictory modes of expression.

Whenever we encounter or seem to encounter an insoluble discrepancy between reality and reason, or rather between what we apprehend as reality and our particular brand of reasoning, we may assume that not the Universe but either our apprehension or our reasoning is at fault. It is an act of faith so to assume; but it is a faith that has been justified in particular instances time and again. The uniformity of nature, the sequence of cause and effect, rests on no surer foundation. Such faith is essential to the pursuit of science; and I presume that faith of that kind is acceptable to theologians. In that faith we shall be wise if we continue, whatever else we may feel constrained to discard. If we could solve all our difficulties while we tramp along, existence would be duller and less stimulating than it is.

Other things interact with matter besides light and gravitation, and thus also have come within our sensory ken. “Life” interacts with matter; so that we are accustomed to observe living things, both animal and vegetable. But what life really is, and how it interacts with matter, we do not know. A department called bio-physics is growing up, which seeks to investigate the interaction of life and matter. Perhaps life is a modification of space too?

ANIMATED matter obeys the laws of physics and chemistry just as ordinary matter does: yes, we may grant that to be true; but yet, when animated, it has something superadded. It has properties not possessed by the inanimate—a kind of spontaneity, a sort of self-determination. Or at the least it is formed into a characteristic shape not dependent on the kind of food supplied. And when in its higher stages life blossoms into consciousness—our own consciousness—we have first-hand knowledge that it is able to form strange conceptions; that it has not only memory of the past, but antici-

pation of the future also; and that it can determine to act accordingly. No mechanism can do that, so we are more than mechanism. We can form plans and carry them out. We can brood and meditate and partly understand. Occasionally we can even predict. We are guided by the future as well as by the past.

If, indeed, life is a manifestation of one of the properties of space-time, it is one of extraordinary interest, for it suggests scope for investigation far beyond anything previously contemplated by science. Mind—whatever it be—leads us into a region of the infinite and the incomprehensible. It seeks to understand. And where it fails to understand it can admire. It can admire the beauty of structure and processes; it can marvel at the adaptation and splendor of nature, the inter-

JUST as science believed it had the ultimate secrets of matter learned, they vanished in its hands. This is an age of marked change, a fitting time to take an inventory. Hence the present article.

—The Editor.

locked intricacies of its laws. And when these too pass beyond its scope, so that they are no longer apprehensible, but merge into the unfamiliar and the eternal, it is overwhelmed by a feeling of awe, and takes refuge in the human faculty of worship.

ASOMEWHAT modified view of mechanism still holds the field; but it is mechanism of a glorified kind. No longer do we expect to explain all even purely physical realities in terms of matter. The old mechanical models of ether will not work. Now that we realize what a comparatively exceptional peculiarity matter is, and how dependent it is on the properties of the medium in which it exists and out of which it is presumably formed, it is in no way surprising that the aim now is rather to explain the behaviour of matter in terms of a more fundamental reality, than to seek to model reality under the guise of a material assemblage. Even the physical universe is far greater than the limited material aspect which appeals to the senses. The true nature of physical phenomena is to be sought in space and its properties. The attempt to find a mechanical ether, and to define it in terms of material machinery, has been perforce given up. Yet the name “ether” may survive, for there is certainly a physical reality filling space. Can it be a substance? It is substantial in that it stands under everything—a truly fundamental substance, although unlike any substance with which we are acquainted.

Herein lies the immediate problem of the future. This may be regarded as the next extensive step or aim in physics—to weld together the newer and the older discoveries into an all-embracing system which shall include them all—although probably it may do so in ways which at present we can barely guess. To make revolutionary progress we must transcend matter and its relative motions, and must formulate the properties of the fundamental entity which fills space and endures in time. There must be something in it of a periodic character which justifies our sense of duration, and accounts for all the properties of matter. The mind is stretched to the utmost, but we do not despair. Rational the universe has always been, and rational it assuredly is. In other words, it is in harmony with the human mind, when that is sufficiently informed and enlightened to perceive the grandeur of truth.

EXPERIENCE has consistently shown that there is a rational process behind everything, and it is possible for us by patient investigation to ascertain the working of the process and to study the laws of its operation. Theologians would surely admit that nothing is accomplished save by rational methods; nor is there any intervention by other than accredited agencies or agents—however transcendent some of them may be. As was said of old about the Logos—the Personification of Reason, of Law and Order—“Without him was not anything made that was made.”

It is the privilege of science to contemplate creation and to work it out; to realize what is happening and to dive down as far as we can to the innermost core of the mystery. We have, indeed, far to go: we have as yet but scratched the surface of things. Only lately have we begun to probe the constitution of the atom; only recently have the stars and nebulae begun to display their hereditary connection. The birth and death of worlds is now being contemplated by science. We are witnessing something of the process of creation actually going on.

Humanity is in its infancy. What wonder if we stumble and halt by the way. Yet we are making progress. We that were walking in darkness have caught a glimpse of a great light. Naturally we are dazzled, and it may be perturbed. But we live in a privileged age. Men of genius as great as any in the past are working among us. Some great generalization is approaching; and mathematical physicists all over the world are contributing to its arrival. The work may have to go on for a century before the sun rises, but through the haze and mists of the twilight we catch a glimpse of a rosy and hopeful dawn.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

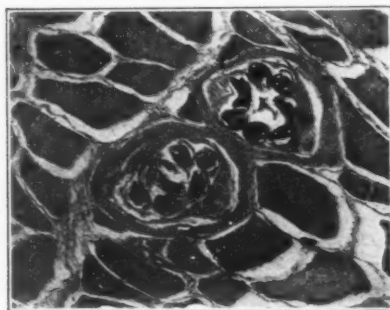
Editor of the Journal of the American Medical Association and of Hygeia

Golf Balls and Lead Poisoning

GOLF balls have been blamed for all sorts of peculiar symptoms and troubles, but it is extremely unusual to find that it is possible for some one to get lead poisoning from contact with the elusive pellets. In a case described by Dr. H. W. Wuerthele, a boy 16 years of age was concerned. He was a caddy. One evening he was suddenly taken with the cramps that are typical of lead poisoning and was found on examination by the physician to have some of the other symptoms associated with lead poisoning. Close questioning revealed that the boy had been cutting open golf balls and rubbing the lead contained in the little rubber sack found within the ball on some old balls that he had found about the links, and which he was preparing for sale to some golf players for use as practice balls. He had probably eaten his lunch without washing his hands and a good deal of lead had entered his system in this manner, producing lead poisoning.

An Epidemic of Trichina

AS long ago as 1821, a German discovered that people could become seriously ill following the eating of infected raw pork and that there were little foreign substances in the muscles in this condition. Not long ago forty-three people in Albany and in communities near Albany, New York, were involved in an epidemic



TRICHINA

A section of pork that caused an epidemic, showing the encysted *Trichinella spiralis*

of trichinosis following the eating of insufficiently cooked or uncooked pork sausage. It appears that two residents of Albany had gone to a neighboring town for a visit and while there

had purchased from a butcher a pig which they brought back to Albany. From the pork, they made sausage with garlic and peppers, and some blood sausage, keeping some of the meat that remained for use as bacon and salt pork.

They operated their home as a boarding house, mostly for Spaniards, and most of the people who were sick had eaten of this pork at the boarding house. When the pork was examined, it was found to contain the organism known as *Trichinella spiralis* and a similar organism was found in tissue removed from thirteen of the persons affected. Practically all of those people suffered with muscle and joint pains, swelling of the face, and general fatigue. Many of them had severe headache and vomited.

Several epidemics of trichina occur regularly each year in the United States due to eating pork that has been infected and which has not been sufficiently cooked.

Treatment of Burns by Skin Grafts

ONE of the unpleasant features of severe burn of the skin is the fact that the skin tends to contract and produce much distortion of the tissue. In order to overcome this condition, modern surgeons remove the skin tissue and substitute for it skin grafts taken from other portions of the body.

Considerable ingenuity has been developed in finding the best place for the transfer of the tissue and in actually moving large sections of skin from one portion of the body to another. In the transfer, the hand or arm which supplies the skin is held in such a position that the extra piece of tissue maintains contact with its original position and blood supply until it has grown into its new place, after which it is severed from the original point and permitted to remain permanently at the new point.

Inhaling Steam

NOT infrequently doctors advise the inhalation of steam for the relief of irritations and swelling in the throat. Various methods have been recommended for this purpose, including the filling of a bowl with hot water and steaming of the entire face and head which are covered with a towel, and the use of a cone of paper or cloth put in the tea kettle or some other vessel of boiling water. In this way

the face, nose, and ears, as well as the throat, are steamed.

A physician in the Massachusetts General Hospital has developed a



INHALING STEAM

A towel covers the mouth of a vessel of boiling water, from which steam is to be inhaled for the treatment of throat irritations

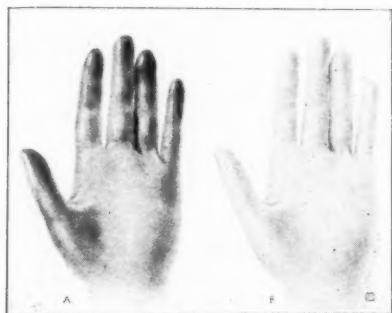
system for this purpose which avoids steaming of the face and nose and permits the application of the steam directly to the throat. The equipment is any metal receptacle containing two quarts or more of boiling water; a tube about a foot long, preferably of rubber; and a towel. As shown in the illustration, one end of the tube goes in the patient's mouth and the other is held about an inch above the surface of the water. The patient then breathes through the mouth, taking rather deep breaths, while the opening of the vessel is closed with the towel. In the use of such a device, care must be taken to have the pitcher or vessel of hot water fixed in such a way that it will not fall over and spill on the patient. The tube may well be clipped to the top of the vessel in such a manner that it will not drop down into the water which would allow the patient to suck the boiling water into the mouth.

Raynaud's Disease and Its Surgical Treatment

RAYNAUD'S disease is one of the most peculiar conditions known to scientific medicine. In this condition the extremities, either the arms or the legs, become blue and indeed proceed to gangrene. There are neu-

ralgic pains, diminished sensibilities of the skin, and a general sensation of coldness. This disease occurs most often in women between 18 and 40 years of age, although cases are frequently seen in men.

A distinction has to be made between this disease and a similar con-



RAYNAUD'S DISEASE

Left hand: A, before nerves were cut. B, following sympathetic nerve root removal

tion known as Buerger's disease, or *thrombo-angitis obliterans*, in which the blood vessels primarily are involved. In many instances in Raynaud's disease there seems to be some relation to a severe psychic disturbance, although associated with this there have been crushing accidents of one type or another.

The condition has heretofore seldom yielded to ordinary methods of treatment. Some years ago it was suggested that the nerves of the sympathetic nervous system, which control the contraction and relaxation of the blood vessels, might be cut apart and in this way permit free circulation of the blood to the extremities affected by Raynaud's disease. Recently an operation was performed on a patient with this condition in which the nerve roots concerned were removed. In the hand on the side on which the nerve roots were removed, the temperature was increased and the circulation was improved. The benefit was so great following the operation on the one side that the patient asked voluntarily for an operation on the other side with a similar good result. More than three months after the operation the results were still maintained. The procedure is one of the most difficult known to modern surgery, but the results are so striking as to cause the investigators to believe that the surgical control of this disease is an accomplished fact.

Leprosy

THE present population of the National Leprosarium in Carville, Louisiana, is 285 lepers. This does not constitute by any means all of the lepers in the United States, since the evidence indicates that there are many cases not recognized. The disease does not actually constitute a general

menace, since infection is only by direct contact. Leprosy is an exceedingly chronic disease, lasting on the average for 14 years from the first appearance of the symptoms.

During a period of 34 years, 718 lepers have been hospitalized in the leper home in Carville, which formerly was a state institution. Of the lepers, 215 were born outside of the United States and 503 in this country. Mexico, China, Italy, and the Philippine Islands furnished one half of the foreign born lepers. Seventy-two and three tenths percent of the patients are male and only 27.7 percent female.

The disease afflicts apparently all classes of the population, the average age at onset being 30 years and the average age of admission to the hospital 36 years, so that in practically every case the persons were free in the community for six years before their condition was correctly diagnosed and arrangements made for hospitalization.

During the last seven and a half years, 28 lepers have been paroled from the Leprosarium and of these only one has had a relapse which made it necessary for him to be taken back into the institution.

Chlorine in Water Purification

THE first practical apparatus for chlorination of water was made in 1913. In 1926, 3200 American communities were using four billion gallons of chlorinated water every day, and the evidence indicates that 70 percent of the population of the United States depends on chlorinated drinking water for its supply. Furthermore, the method has been adopted for swimming pool disinfection, disinfection of water mains, and the treatment of water used by travelers.

When chlorination was first introduced, all sorts of superstitions developed as to possible dangers, including the belief that it would cause sterility, cancer, or Bright's disease, and decrease the birth rate. It is no longer necessary to contradict such notions, although in time of epidemic they are likely to develop again.

Chlorinating apparatus is manufactured today in the United States, England, Germany, and Spain. In some countries of South America installations have been made so rapidly that practically the entire drinking water supply is chlorinated. In many places water is filtered first and then chlorinated; in other places, chlorinated before filtration and after, and in some places, where considerable doubt exists as to the quality of the water from the point of view of infection, repeated chlorination is practiced.

For swimming pools, the Joint Committee on Bathing Places of the American Public Health Association and the Conference of Sanitary Engineers has decided on chlorination as

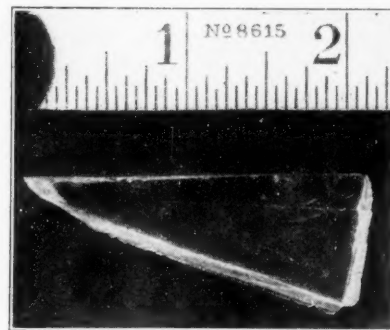
the method to be used. Next to treatment with chlorine as a gas or watery solution, continuous application of a solution of sodium hypochlorite is recommended. The amount of available or excess chlorine in the water at all times when the pool is in use should be not less than 0.1 part per million and not more than 0.5 part per million.

For travelers, chlorine disinfection is practiced by the use of tablets of compound chlorine; the substance most often recommended is Halazone. If the water is turbid, it is preferably filtered first and then chlorinated in order to purify it.

Glass in the Glottis

ON December 11, 1927, a man was thrown through a windshield in an automobile accident. When he was picked up, the left side of his neck was found to be lacerated and he was unconscious due to concussion of the brain. He was taken to a hospital and there a piece of plate glass one and one half inches long and one half an inch wide was removed from the wound in his neck and the wound closed. Three weeks later he was well and returned to his work as an installer of furnaces. For several months thereafter, however, he continued to complain that he had difficulty in talking and he constantly had a great deal of mucus and purulent matter discharging from his throat. He complained also of trouble in swallowing.

Finally, after four months had passed, he went into a hospital for treatment and it was planned to remove his tonsils. Investigation showed an abscess in the lower side of one tonsil. When an attempt was made to wipe away the secretion from this abscess, a hard mass was found. The operator grasped this mass with his forceps and after some manipulation was able to remove it. It was



GLASS

This piece of glass was removed from a man's glottis. Note in particular the sharp edges

found to be a triangular piece of plate glass measuring two and one-quarter inches by one inch. This glass had remained in the glottis for 116 days, causing all this time irritation, swelling, and general disturbance.



KEEVISK, MEDICINE MAN

Some of his exploits are described in the author's article. Secrets will die with him

THE steady throb of a tom-tom sounded over the Moapa desert in southern Nevada. Occasionally the shrill voice of an Indian chanting could be heard coming from the grass covered *wickiup* near the bank of a sluggish, muddy stream. It was Grasshopper, a Piute Indian medicine-man, working over a sick woman. For three days the old fellow had been doctoring his patient, without apparent effect. All the herb mixtures and magic formulas that Grasshopper knew had failed to rally the sick squaw, and the old Indian was in despair. His voice grew harsh as the night wore on, and the beat of the tom-tom grew wilder until, with a muffled roll, it stopped for a moment, started again with a soft echoing throb, remained mute.

Grasshopper had failed.

THE next morning the desert sun, creeping over the horizon like a golden ball, revealed an odd sight. In front of the *wickiup* in which the doctoring had taken place, lay the body of a man. It was Grasshopper, strangled to death according to the unwritten laws of his people. For if three patients succumb to disease among this group of American Indians, the doctor is put to death; and he is sometimes killed for refusing to treat an ailing person when asked to do so by relatives. Medicine-men who were not successful in effecting cures among the Piutes did not live long.

The Vanishing American Indian Medicine-Man

With the Passing of the Tribal Wise Men, the Secrets of the Remedies Used by These Primitive Practitioners Are Being Lost to the World

By DONALD A. CADZOW

Museum of the American Indian, Heye Foundation

Some fake doctors, probably through "magic" and "thought cures," prospered for a time among the American Indians, but the real medicine-man, as known to the average tribe, was the one who treated his patients by the use of herbs, barks, and roots of certain trees and shrubs, the knowledge concerning the use of which has been handed down through the ages. Many of the most potent remedies have been lost to mankind within the past generation, for many an old medicine-man has taken his secrets with him to the grave, rather than have them used by someone who did not have a sincere belief in the old Indian ways.

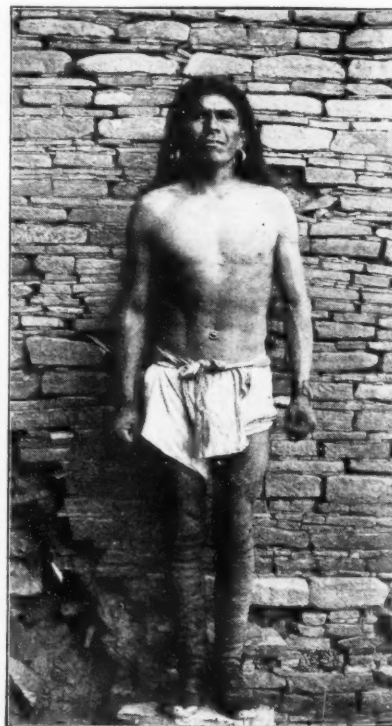
In mixing concoctions for various ailments, a medicine-man will sometimes use many different herbs, roots, and barks, and then, again, a single species of plant is used. Trips involving, in some cases, hundreds of miles are made to obtain plants that do not grow in the section in which the "doctor" lives. Many botanists have been amazed at the uncanny knowledge some Indians have regarding the flora of regions at great distances from their homes.

KEEVISK, a Cree Indian, who makes his home on the File Hills reservation in the Province of Saskatchewan, Canada, is one of the last of the great medicine-men left in the West. He is very old and partially blind from trachoma, a disease brought to his people by the white man. But regardless of his affliction, he still practices his ancient art passed down to him from his father, and he cures his patients of many ailments. He can see only dimly the objects he uses, but his senses of taste, smell, and feeling are supernormal. And, unerringly, he selects medicines from his store.

I had heard of this great healer, Keevisk, from the Bungi Indians who live hundreds of miles to the east of his home. They told of the remarkable things this man has accomplished, and I was particularly anxious to see and talk to the old fellow. He was sitting cross-legged on an old cow-skin as my

interpreter and I entered his tent. After the customary salutations and exchange of tobacco, the old man, speaking through the interpreter, asked if I wanted something to cure my sore throat. I had one all right, as I knew only too well, but how Keevisk knew it is more than I can fathom. He gave me a piece of root to chew and in a few minutes my throat felt better, and that night the soreness disappeared entirely.

While I was visiting with Keevisk the following day, a white man came to his tent and asked the old fellow for his medicine. According to this man's story, he was a rancher and an ex-Canadian soldier, who had contracted a skin disease in France during the war. Several army doctors had worked on him without any apparent results.



JUAN, A NAVAHO

Navaho performers apply torches to their naked bodies when "making medicine"

Keevisk had been giving him medicine for three months and his skin was almost clear.

In the interest of science I tried to gather some of Keevisk's formulas, but the old man was very reticent about passing them on. Most of them will die with him, as he has no son with whom he will trust his secrets.

The Seminole Indians of the Florida Everglades, the Creeks, the Choctaws, and other tribes who live in the southeastern part of the United States, had a great number of medicine-men. Some of these men were herb doctors, but most of them were magicians who were supposed to have the power to dispel disease by chanting certain secret formulas. In many ways their cures were effected by making the patient believe that he was recovering, and very often he did. Illness within these tribes was generally believed to have been caused by an animal that had the disease and passed it on to a human being. Carrying a fetish made from some part of this animal was supposed to be a great help for a sick person. Because of this belief, a good medicine-man always had fetishes or charms, created out of various parts of the animals of the region. These were always sold to patients at a very good profit.

AMONG the Navahos and Pueblos, who live in the southwestern deserts, medicine-men and medicine-women still thrive. The Pueblos have specialists for various forms of disease, and have had them for centuries. Among these people we also find some of the original rubbing doctors or chiropractors, who work their cures by massaging the spine and other parts of the body.

Pocia, a Zuñi Pueblo Indian, still



MEDICINE WOMAN

As with the white race, so with the Indian, there are "medicine women"

practices his ancient art of rubbing away sickness, in the village of Ojo Caliente, not far from St. Johns, Arizona. A few years ago an expedition which I was with, was digging into an ancient ruin in this region, when the stone walls of one of the rooms fell upon an Indian workman, named Waiku. He was carried into our camp badly bruised and apparently a very sick man. Upon his request, I went post-haste for three medicine-men. Among them was Pocia. When I arrived with the delegation of doctors, Waiku was lying upon a cot, and, if appearances meant anything, he was well on his way to join his fathers.

It did not take Pocia long to get into action. Waiku was stripped of his scanty clothing and every bone in his rangy body was carefully felt by Pocia. His spine was massaged, and upon being informed by a man in whom he had absolute faith, that everything was all right, he took a new lease on life. A healing lotion for bruises was rubbed on Waiku's body by another medicine-man and he sat up on the side of the cot. The third medicine-man chanted a few magic songs to drive away the evil spirits that had caused the wall to fall, and in a short time Waiku walked home to his family.

Very often animal and mineral substances are used by medicine-men among the southwest Indians. The bite of a snake is treated by applying to the wound a portion of the ventral surface of the body of the same snake.

THE Papego doctors sometimes made their patients eat crickets as medicine; the Tarahumare doctors, lizards; and the Apache had great faith in the use of spider eggs.

The Hopi Indians blow fire on an inflamed surface to counteract the supposed fire within the body which causes the ailment. The medicine-men of this tribe are also believed to have a positive cure for the bite of a rattlesnake. Many men have tried to find out what this cure is, but without results. Thousands of white people have seen them handle rattlesnakes in their famous snake dance without ill after-effect.

The most accomplished of the medicine-men among the Indian tribes south of the United States-Mexican line practiced a primitive surgery, by external manipulation, and otherwise. Probably the highest surgical achievement practiced, in part, at least, as a curative method, was trephining, or taking a small disk from the top of the skull. Why this was done no one seems to know. But the practice is very ancient, as the skulls of many of the Indians of Peru, upon being excavated by archaeologists, are found to have been trephined.

Dental surgery was also practiced in ancient times by the people of some parts of Central and South America. Occasionally, skulls have been found



MEDICINE BUNDLES

Tied to a stick behind the tent of a medicine doctor. They contain magic objects

by explorers with the enamel of the front teeth very skillfully scraped off and round solid gold disks inset. Teeth are still extracted by very painful methods among many of the tribes.

Scarifying, or bleeding, at the seat of pain was common among most Indians. In some places this was done with a cupping horn which was placed over a small incision and the blood sucked out by a medicine-man. I have seen the chests and arms of an Eskimo a solid mass of scars from blood-letting.

The cause and the nature of disease being, to the Indian, in a large part mysterious, he often assigned them to supernatural agencies. In general, every illness that could not be attributed to a visible influence was regarded as an effect brought about by malevolent or offended supernatural beings, or through sorcery or magic practiced by an enemy. These beliefs were general and directly the cause of the practice of these arts.

MAGICIANS and sorcerers were, as a general rule, very different from the herb doctor or real medicine-man. Many of the old explorers in the New World marveled at the powers of the Indian magicians, and in their writings attributed this power to Satan. Father Acosta, in the 16th Century, spoke in awe of the Mexican magicians flying through the air and assuming any form they desired. The Reverend Peter Jones wrote in the early part of the 19th Century: "I have sometimes been inclined to think that, if witchcraft still exists in the world, it is to be found among the aborigines of America." His experience was among the Chippewas who had their homes around



QUALALATI

A cheerful example of the effect of the white man on the Loucheux Indians of Alaska

the north shores of the Great Lakes.

Some of the feats of Indian magicians are easily explained as sleight-of-hand tricks. Their deceptions are very often ingenious, when one stops to consider how crude are their tools and appliances. Many of their conjuring tricks have never been explained, however, and many of them have passed on with their masters.

When I was in the arctic regions I met an Eskimo magician called Pokiak. After convincing him that I had great faith in his so-called powers, I was allowed to "sit in" at one of his seances, together with several Eskimos. The dim light from the flickering stone lamp flashing against the snow walls seemed to cast a supernatural glow and I allowed myself to relax and fall under his spell. First, two huge and ugly teeth seemed to grow from his mouth and protrude almost to his chin. In an instant this apparition faded and a tame martin, or American sable, walked over my shoulders and lap. It sprang from my lap into the arms of Pokiak and then disappeared.

NEXT, we were taken on an imaginary trip to the Moon. We were all told to kneel with our noses pressed to the ground. The magician commenced to chant and sing in Eskimo, all the while whirling something over our heads. In the interest of science, I "peeked" and was rewarded with a bang on the head; and then I saw stars and planets in great numbers skimming past. That incident broke up the

seance, but I later learned that Pokiak stood in the center of our little group whirling over our heads a rock attached to a cord, and the Eskimos knew what to expect if they "peeked." But, of course, I did not.

Many white men who have lived with or near the American Indians have tried to discover how their "moccasin telegraph" works. In reality this appears to be a telepathic knowledge of events occurring in distant places, in some cases hundreds of miles away. My own experience with this telegraph was in the MacDougal Pass, in the northern part of the Rockies. It was my intention to cross over from the Mackenzie to the Yukon via this Pass. No one, to my positive knowledge, went through that Pass ahead of me that season. Yet the Indians on the Yukon side were ready and waiting with collections of specimens for me when I arrived on their side of the mountains.

A stunt among many tribes of the far north was to bind a magician hand and foot, and then, without visible aid or effort on his part, he would release himself from the bonds. Civilized conjurers who perform a similar trick are usually hidden in a cabinet and claim supernatural assistance. Most of the Indians do this feat under observation. A very common trick among Indian charlatans was to pretend to suck foreign bodies, such as stones, out of the persons of their patients. Records of this are found among many tribes from those lowest in culture to the highest in the scale of progress.

NAVAJO performers, naked except for breechcloth and moccasins, and having their bodies daubed with white clay, run at high speed around a fire holding in their hands torches made of cedar-bark, which they apply to the bare backs of those running ahead of them, and to their own person, yet they never seem to be injured by the flame.

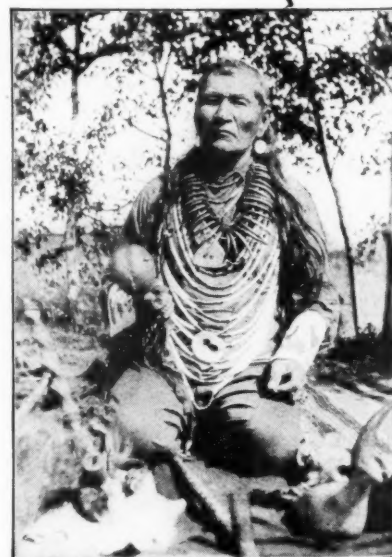
I have seen a naked Indian magician place a wooden sword, about 14 inches long, in his mouth and force it down into his throat until only the feather decorations on the end protruded. Then, to prove he was not faking, he placed another stick in his mouth and forced that into his throat beside the first. I examined and purchased the sticks with which this stunt was performed and convinced myself that they did not collapse when placed in his mouth.

I have met a number of white men in the west who have a great deal of faith in Indian medicine. But probably the most interesting and sincere of these was an old "desert rat" down in the Moapa section of Nevada. The Piutes called the old fellow "Red Wolf." At some time in the past an Indian medicine-man had cured Red Wolf of a

variety of ailments which he had, or imagined he had. The doctors did not use herbs to cure him, but a tom-tom. The vibrations from the steady beat of the drum regulated Red Wolf's body and put it back into tune so he said. The old fellow had not always been an outcast. He could, if he felt in the mood, tell of the years he had spent in an eastern college, and under his tousled graying hair was a good bit of "gray matter," which he liked to use whenever he heard anyone arguing against the medicine-men.

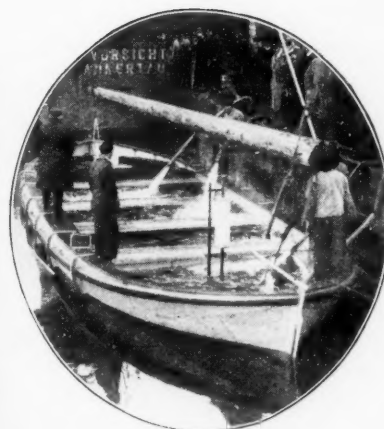
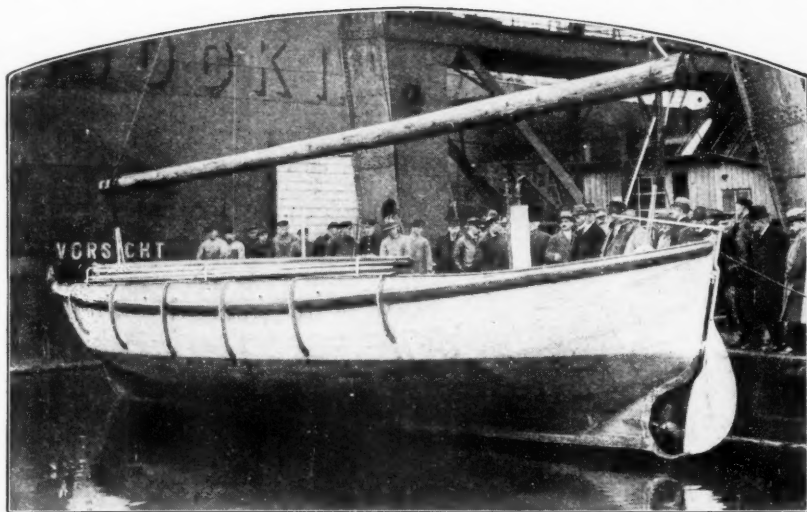
Among the Loucheux Indians, in Alaska, I knew an old chap named John Blackfox. One day I saw him near the Indian graveyard chopping all the trees down between it and the river. I asked him why he was doing this and he told me of a very powerful medicine-man who was making evil medicine against him, and he was going to die. He had always loved the river and wanted to be able to see it after he was gone, so he was preparing a way. About four months passed and old John waited in vain for the evil medicine to kill him. Finally he could stand the suspense no longer and shot his head off with a gun.

IN every Indian tribe there were, and in some tribes still are, a number of men and women who are credited with supernatural powers which enable them to recognize, antagonize, or cure disease at will. But the Indian magician and medicine-man are rapidly disappearing from the American continent. Many of their secret formulas and magic tricks have been lost within the last generation. And in the next twenty years civilization will have wiped out all trace of this extremely interesting art of the aborigines of America.



BUNGI MEDICINE MAN

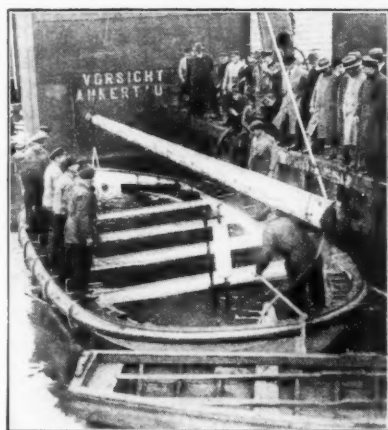
The photograph was taken when he was "making medicine" by shaking a rattle

**145 PASSENGERS**

Loaded with scrap equal to that number of passengers, it floats even when flooded

NO MEASURABLE DEFLECTION

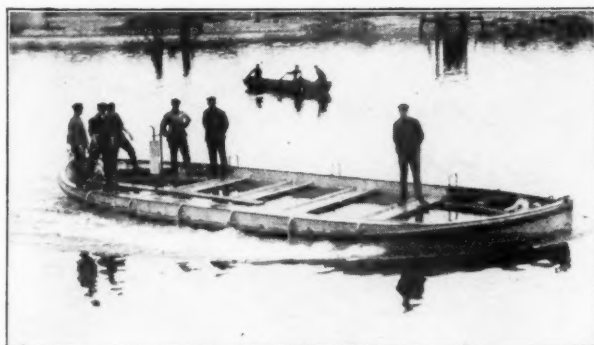
When loaded with 25 percent extra weight and suspended, the new life-boat holds its shape and does not spring seams

**NON-CAPSIZING**

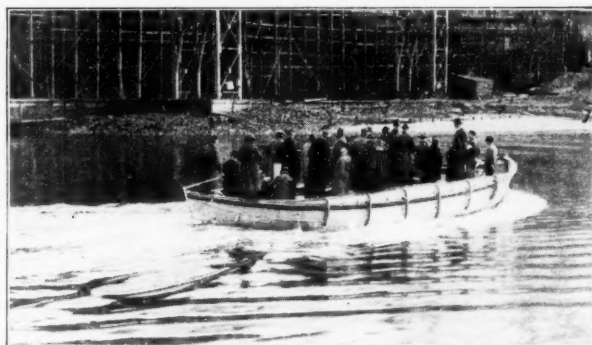
Loaded with scrap and water, the boat does not tip with eight men on one side

**SIX MEN CAN ROW THE NEW LIFE-BOAT**

Usually, in case of a shipwreck in which the passengers take to the boats, the boat must simply head into the wind. The new boat can be rowed by six men when heavily loaded

**THE MOTOR RUNS UNDER WATER**

On a trial run with the boat fully loaded and flooded and the motor running in its closed compartment, the speed was satisfactory

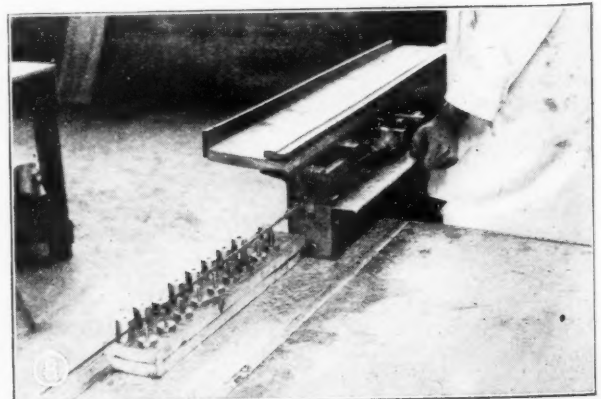
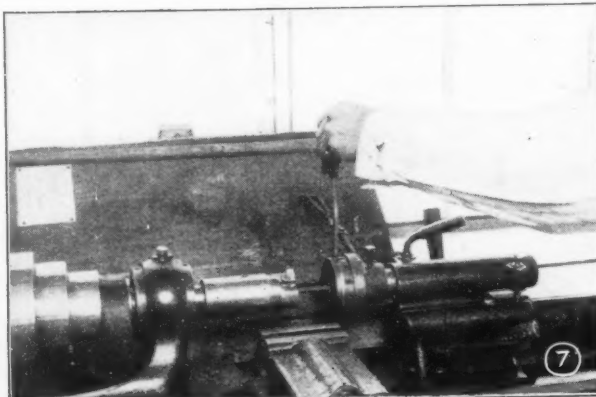
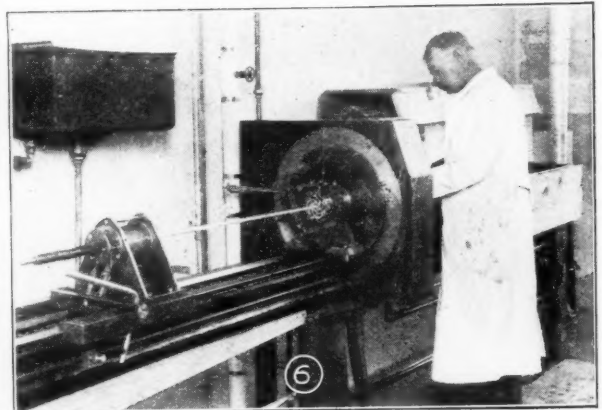
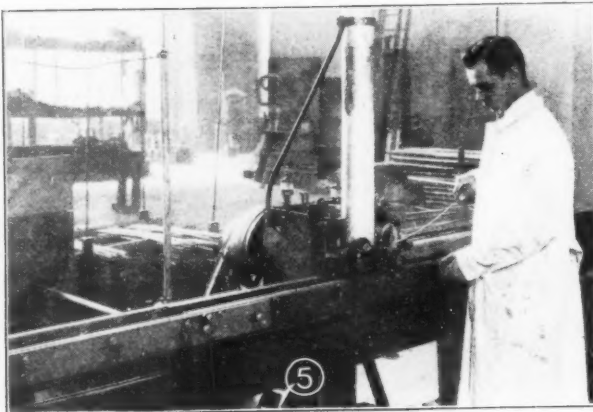
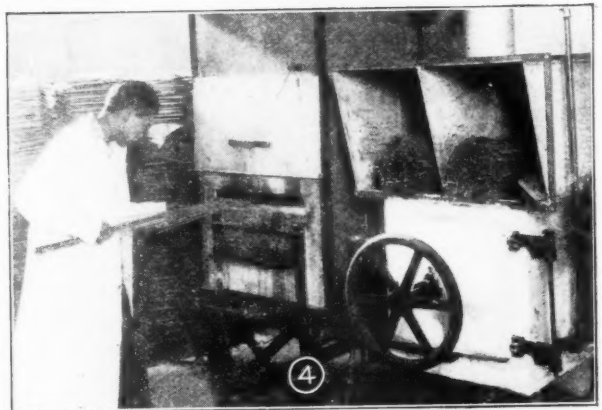
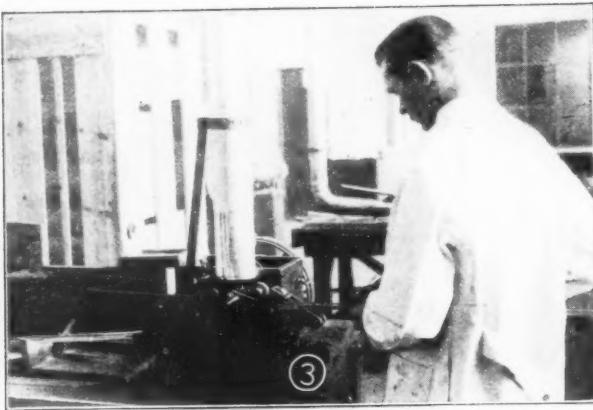
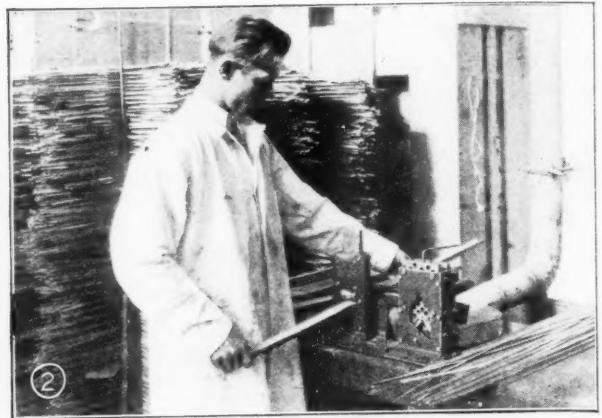
**SPEEDING WITH A VERY HEAVY LOAD**

A speed of six knots was made on a trial run although the boat was loaded with scrap equivalent to 145 passengers and carried 30

A New Life-boat for Greater Safety at Sea

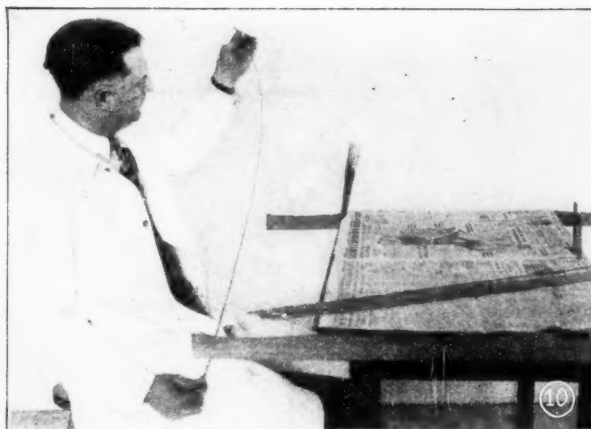
DISASTERS at sea cannot always be avoided, and when one occurs, the saving of many lives may depend upon the kind of life-boats with which the stricken ship is equipped. The new life-boat illustrated on this page, which has been designed and built in Germany, has certain unique features and has shown in tests that it is superior in several respects to those generally used. It is a metal shell boat with air chambers that prevent it from

sinking. It is propelled by a gasoline motor which is enclosed in a water-tight compartment. The air intake to the carburetor and the exhaust pipe extend above the boat so that the motor will continue to run even though the boat becomes filled with water. Tests have been made with this boat loaded with scrap iron and it has remained afloat even though flooded and heavily weighted with scrap and men. Apparently it is a very sea-worthy craft.



All photographs courtesy Goodwin Granger Company

ILLUSTRATIONS DESCRIBED ON OPPOSITE PAGE



From Bamboo Forests to Fishing Rods

*The Modern Split-Bamboo Fishing Rod Is a Far Cry
From the Crude "Pole" of Boyhood Days*

TO dwellers in Eastern lands, the bamboo tree furnishes frames for houses, material for rafts and boats, containers for water, food, and the like, and other necessities of life. To those in other lands where the pressure of necessity is lightened by a diversity of materials, the term "bamboo" usually conjures up a vision of split-bamboo sun-screens for the front porch, or—more likely—of favorite fishing spots where the bamboo rod reigns supreme. The barefoot boy of story and song whistled on his way to the nearby stream with a single stick of bamboo over his shoulder, bought for a few cents at the general store. The moneyed fisherman rolls smoothly in his car to the best trout stream or bass lake, and in the tonneau repose finely finished split-bamboo fishing rods, each a masterpiece of modern craftsmanship. And in be-

tween these two extremes are to be found all kinds of split-bamboo rods ranging in price from a few dollars to 50 dollars or more.

A good split-bamboo rod is such a thing of beauty and obviously hides within it such a display of expert workmanship, that we are sure many of our readers will be interested in the photographs on this and the opposite pages wherein are shown the various steps in the manufacture of rods of this type. These photographs are described in the following paragraphs.

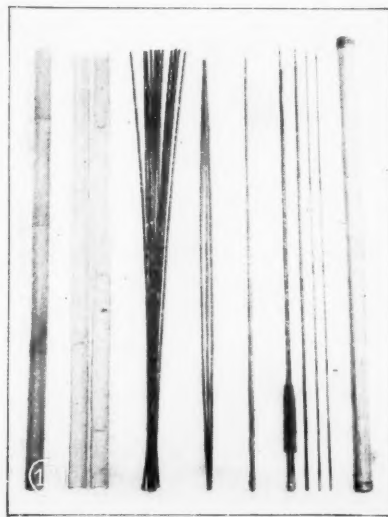
Opposite page: (1) The preliminary work on the Chinese Tonkin cane, which is conceded to be the best for

operations. In this machine, a temporary winding is put on to hold the strips while drying. Temperatures must be kept constant. (7) The end of the rod is shaped to receive the ferrule. (8) Setting the ferrule, which must be straight with the rod.

This page: (9) The finishing touches of straightening and truing. (10) Inspecting and testing a tip section before winding. (11) Cork disks for the grip are glued in place and then shaped. (12) The guides are fastened in place with silk wrappings. (13) Steps in the manufacturing process from the raw cane to a finished rod and its protecting case. From left to right there are: the bamboo as it comes from the forest; the sand-papered cane, the split strips; the shaped strips ready for glueing; the glued rod with temporary bindings; the finished rod in all its quiet beauty; and the case for the rod.



fishing rods. Sandpaper is used to remove the "nodes" or joints before splitting. (2) This machine will split the most crooked cane absolutely with the grain. (3) Here the strips are cut so that their cross-section is a perfect equilateral triangle. (4) The strips are straightened and cured. This rapid process is equal to 20 years of ordinary seasoning. (5) Sizing and tapering. The strips are cut to a uniform accuracy of one one-thousandth of an inch. (6) Glueing, the most important of all





THE average American citizen has, I believe, decided that the airplane, which is daily being rapidly developed for commercial and military uses, will be an important weapon in the next great war. Large bombing planes have already been built which are capable of carrying 2000-pound bombs at high altitudes and for long distances. One readily imagines the destruction which could be spread over a country with such weapons. Swiftly flying planes mounting many machine guns can be pictured spreading terror and destruction as they fly low over cities, camps, or armies on the march. The possibilities for destruction seem almost unlimited, and some military enthusiasts have stated that the airplane will render obsolete all other types of weapons and methods of warfare on land and sea. In short, the popular present-day sentiment is that the next war will be fought in the air.

The airplane came to the front as an important arm of the service with great rapidity during the World War. Although in 1914 it was almost unknown as an instrument of war, in 1918 over 480 German machines were employed in attacks on Paris alone.

IN England the rise and decline of airplane raids is indicated by the following statistics: Up to the end of 1916 there had been 19 attacks in which bombs had been dropped. In 1917 there were over 26 attacks in which 51 tons of bombs were used, while during the last year of the war, due to the increased efficacy of the combined air and anti-aircraft defenses, there were only six raids in which 22 tons of bombs were dropped. The airplane was also found to be of invaluable service for reconnaissance, mapping, photographing, and for directing artillery fire.

During this period there were two principal means of defense against the airplane: other airplanes, and guns. It is not within the scope of this article to review the advantages and disadvantages of the two types of defense; suffice it to say that official records indicate that approximately five airplanes were destroyed by aircraft to one destroyed by gun-fire. In fairness to the anti-aircraft artillery it should be pointed out that the ground defenses were of the greatest assistance to the air defenses, since they aided in locating the enemy aircraft.

An observer on the ground usually

The Guns Against the Airplane

New Anti-aircraft Matériel and Fire Control Methods Put the Airplane in its Place as an Important War Auxiliary

By MAJOR G. M. BARNES
Ordnance Department, United States Army

can see more of what is taking place in the air than can one in an airplane. The shrapnel or shell-bursts of the anti-aircraft artillery were used to point out the enemy planes to the defending air forces. Also, in night attacks, the defending planes were helpless unless enemy planes could be located and illuminated by the searchlights of the ground defenses. Thus, many planes credited as destroyed by aircraft were really destroyed by the close co-operation of the air and ground defenses.

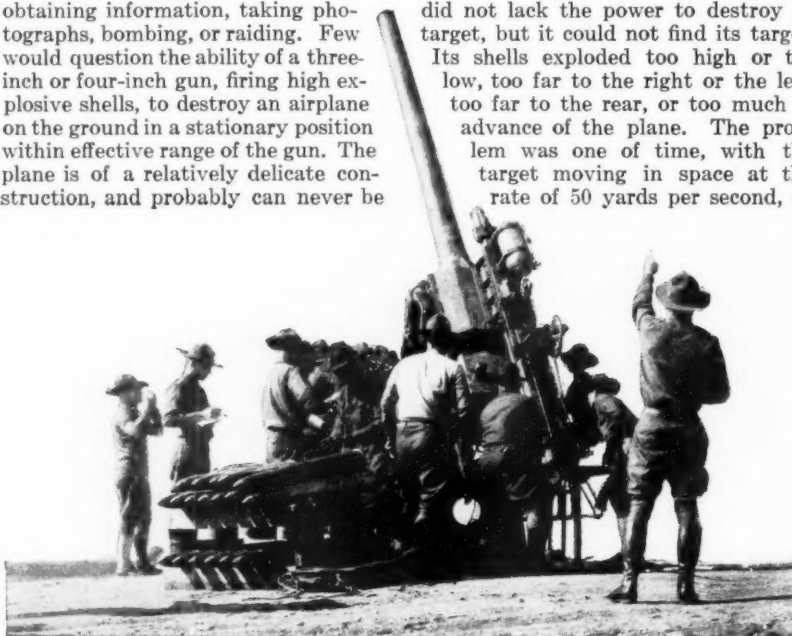
Looking back over the war period it is surprising to the writer that the crude anti-aircraft artillery and fire control existing at that time could have established such a favorable record. It is the purpose of this article to describe as briefly as possible the astonishing developments which have since been made in the art of anti-aircraft fire.

The principal rôle of the gun is to destroy the airplane, or to force it to climb to such high altitudes that it cannot accomplish its mission of obtaining information, taking photographs, bombing, or raiding. Few would question the ability of a three-inch or four-inch gun, firing high explosive shells, to destroy an airplane on the ground in a stationary position within effective range of the gun. The plane is of a relatively delicate construction, and probably can never be

armored with plates of sufficient thickness to keep out the fragments of high-explosive shell, which depart into space from the point of detonation at the tremendous velocity of 4000 feet per second. The weight of such armor would be prohibitive.

It is unnecessary that the shell burst exactly at the plane, for the fragments extend outward from the point of detonation forming a relatively solid mass like a mushroom, the stem pointing in the direction of fire. An airplane 150 feet to the right or left, or 300 feet in advance of the point of burst would be within the effective range of the shell fragments. Thus the plane depends for safety on its great speed and the fact that it can move through space in three dimensions.

THE reason the anti-aircraft gun did not make a more favorable record in the World War can now be quickly stated. The gun of that period did not lack the range or the ability to reach the airplane in the heavens; it did not lack the power to destroy its target, but it could not find its target. Its shells exploded too high or too low, too far to the right or the left, too far to the rear, or too much in advance of the plane. The problem was one of time, with the target moving in space at the rate of 50 yards per second, or



A MODERN ANTI-AIRCRAFT GUN IN ACTION

This 105-millimeter gun is one of the latest developed types for seacoast and fixed defenses. It fires 15 33-pound projectiles per minute—vertical range 12,000 yards, horizontal, 19,000

more. All elements of gun laying, namely, direction, elevation, and fuse range, were changing with great rapidity. In attempting to place the center of impact of the fire on the target, it was natural that the methods successfully employed for controlling the fire of field artillery should be used first. These methods were soon found to be inadequate, and new ones of every description were tried. Attempts were made to calculate the future position of the target by various curves, slide rules, and the like. The approximate data thus obtained were telephoned to the guns, set off, and the guns fired as quickly as possible, with the result that the airplane, with average luck, continued on its way undisturbed by the rain of fragments far to the rear.

AFTER the war, the Ordnance Department of the Army, taking advantage of the war teachings, inaugurated the development and construction of entirely new weapons of all types. This work has resulted in new types of equipment for all branches of the service, greatly excelling the World War types. Anti-aircraft artillery and its fire control has also been extensively developed, and the new equipment represents a great advance.

In the new method of anti-aircraft fire control, it is necessary to know first the altitude of the airplane above the ground at all times. This is used instead of range. The aviator in the plane knows this altitude reasonably well from his instruments. It can be measured even more accurately from the ground by means of the stereoscopic height finder, an optical instrument developed especially for this purpose. The necessary firing



FIRING CLIPS OF FIVE SHELLS LIKE A RIFLE

The Browning 37-millimeter, full automatic gun firing at a towed sleeve target a mile away. It fires from 60 to 90 projectiles per minute, each weighing one and one quarter pounds

data for the guns are computed automatically by the anti-aircraft director, a calculating machine which, if kept directed at the target by means of two telescopes, will not only continu-

Now if the gun could be continuously trained, say electrically, to follow the data indicated by the director so that no time would be lost, the gun could keep step with the movements of the target. This has recently been accomplished. The new guns, driven electrically, move in elevation and train by just the calculated amount to place the burst at the target. The other element entering into the problem—the time setting of the fuse to burst the shell at the proper point along the trajectory—is also computed by the same instrument. Here, again, the old artillery hand fuse setter has been abandoned for the new fuse setting machine, which is kept in step by means of an electrical data transmission system working with the data furnished by the director.

Approved by Secretary of War

BEFORE sending this article to us, Major Barnes submitted it to army departmental heads for approval. When it reached us it had appended the recommendations of the Chief of Ordnance and the Chief of Coast Artillery that it be approved, and an order from the office of the Secretary of War authorizing its publication.

It was the good fortune of the editor of this article to witness at Aberdeen Proving Ground last fall anti-aircraft tests such as those described herein. In consideration of the excellent results obtained at that time, we believe that the author is conservative in evaluating the newer anti-aircraft guns and equipment.

—The Editor.

ously compute the range, speed, and course of the plane, but will also indicate continuously the elevation and direction at which the gun should be set so that it will point ahead of the target by the correct amount at all times. The gun must lead the target since the projectile requires several seconds to reach the plane.

By means of this new calculating device the anti-aircraft guns are set to lead the target by an amount mathematically computed for the conditions existing, based upon the height, speed, and course of the plane at the time of fire. The artilleryman will know that it is necessary also to make corrections for the drift of the projectile, the direction and velocity of the wind, the muzzle velocity of the gun, and the density of the atmosphere at the time of fire. The machine also computes these quantities and corrects the final answers in accordance with the known data.

Many improvements in guns and ammunition have also been made. The new anti-aircraft guns have higher muzzle velocities in order that the shell may reach its target more quickly. The new projectiles have streamline shapes, which offer less resistance to the air. The fuses perfected for the field artillery for use in destroying targets on the ground, have been found to be erratic when fired into the higher altitudes, where the atmosphere is less dense. Clock fuses, which will operate with uniform accuracy, at all ranges and altitudes, will become a part of the new anti-aircraft matériel.

DURING the last four years some 20,000 rounds of ammunition have been fired at sleeve targets towed by airplanes, during day and night tests, with the new anti-aircraft guns and devices. The results with the latest weapons and fire control are very important, and bring one to the realization that the anti-aircraft gun will fill a decidedly more important place in the future. In the 1925 tests, towed sleeve targets were occasionally



GUN BATTERY COMPUTING MACHINE

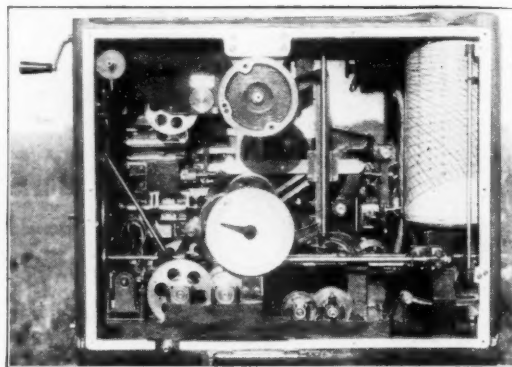
This instrument tracks the airplane and controls the setting of the guns in an anti-aircraft battery

shot down. To shoot down the cloth sleeve towed at high speed by the bomber, it is necessary to cut the 3/16-inch steel towing cable by severing it with a shrapnel ball. (This is the type of ammunition used in target practices; the more destructive high-explosive shell would be fired in time of war.) During the 1927 and 1928 practices, targets at which 50 to 60 shots had been fired showed shrapnel holes almost without exception, and targets were frequently shot down.

A NEWSPAPER correspondent, in an article written concerning a firing demonstration which he witnessed, praised the accuracy of the firing but pointed out that the range and altitude of the target were known to the firing battery. Nothing could be farther from the truth. The only restrictions placed as to the course of the target is that it fly over areas at the Proving Ground owned and patrolled by the government. The direction of the course of the plane must also be such that the pilot in the towing plane will not be in danger. It is of

effective is about 38 percent; and at a range of four miles, 25 percent. These percentages would be greater for the four-inch gun. As the actual percentages now obtained are about one fourth as much, here is an indication that future progress in fire control will result in increased accuracy, even though no other improvements be made in the gun or its ammunition.

While the tests were conducted to obtain the best possible data concerning the accuracy of the anti-aircraft fire, it is of course impossible to simulate the conditions which will prevail in time of war. The aviator would naturally take steps to protect himself by using smoke screens and by flying zigzag courses. These measures would help the aviator to avoid destruction. However, as to concealment, and zigzag flying, it must be remembered that an anti-air-



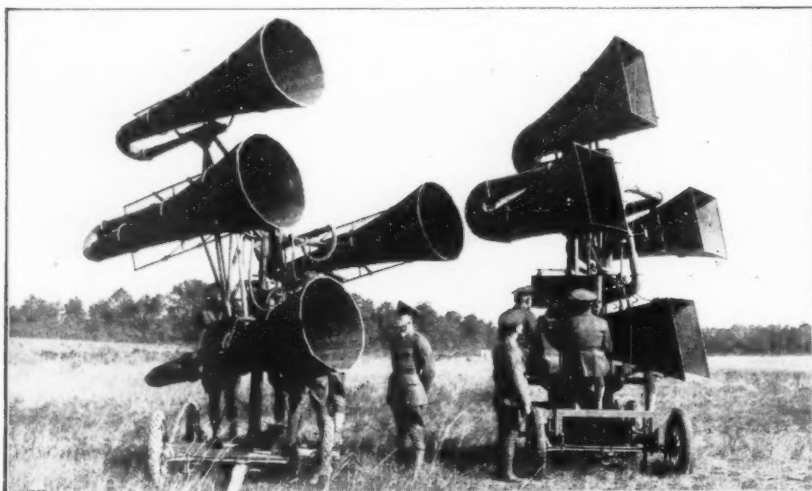
COMPUTING MACHINE MECHANISM

The complicated works of the new apparatus which calculates location, speed, and course of the target

craft battery on the ground would be difficult to detect from the air two to four miles away. The aviator will not know when he is coming under gun range unless he has knowledge of the location of the battery.

A four-gun battery of three-inch guns will deliver an average of 100 shots per minute. When the aviator sees the first burst, if at a range of approximately two and one half miles from the battery, there will be more than 16 shots already on the way toward the plane. Adverse weather conditions usually favor the gun, since the aviator must see in order successfully to attack a ground target, using bombs and machine guns. He must fly below the clouds and thus come closer to the anti-aircraft guns.

AT night the airplane can be detected by the noises made by the engine and the swishing of the air past the machine. The listening horns, or sound locators, as they are known, can track the plane by sound. Up to date these noises, which give away the position of the plane to the ground troops, have not been eliminated. The super-charger which is being developed to



DIRECTION FINDERS

Improved sound locators with which an airplane up to 12 miles away can be heard

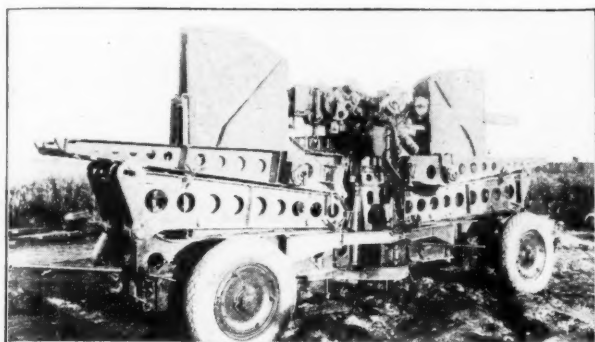
the greatest credit to the personnel of both the Anti-aircraft Artillery and the Air Service that, in the three years during which these extensive anti-aircraft firings have been conducted, day and night tests have been flown without accidents, and neither the aviators nor the planes have been endangered by the firing.

To those who doubt that the anti-aircraft gun has sufficient accuracy to combat aircraft, it may be of interest that the probability of bursting shells at a point near enough to the plane to be effective has been calculated, assuming no errors in laying the gun. Thus, at a range of say two and one half miles, if the gun is correctly laid continuously, the probability of a shot being



STEREOSCOPIC HEIGHT FINDER

The sighted airplane is the apex of a triangle, of which the base and its two adjacent angles are known (distance between the telescopes, and their declination). The rest is mathematics



A MOBILE THREE-INCH GUN

A post-war development. The gun and its entire equipment is constructed so that it can be quickly folded away on its trailer



MOBILE THREE-INCH GUNS IN ACTION

A battery of guns, of the type shown at the left, in action. Each of these guns fires 15-pound projectiles at the rate of 28 a minute

allow the plane to fly at higher altitudes, seems to increase these noises.

The sound locator gives continuously the approximate location of the plane. Powerful searchlights, electrically controlled, search around the moving point indicated by the horns. The plane, once picked up by modern searchlights, cannot rid itself of the beam by diving, twisting, turning, or other maneuvering. Frequent tests have verified this to be a fact. When the target is once illuminated by the searchlight, the same methods of firing are used as those employed for day fire.

THE defense against bombing planes at night is by no means perfect. The airplane has a chance to evade the horns, especially if an insufficient number is present for the defense of the area. On the other hand, night operations also offer great difficulties to the aviator, who is flying over

unknown territory in the darkness.

For bombing aircraft flying at the lower altitudes, the three-inch gun is ideal, and tests have shown that the gun can follow the target successfully as it rushes past the battery at ranges of less than a mile. However, machine guns, being much lighter and mobile, are important anti-aircraft weapons for ranges up to one and one-half miles. Four machine guns mounted together on a single mount, each mount firing 500 shots per minute, can literally spray the target with machine-gun bullets. Attempts were made at first to shoot the machine gun by the eye, or by roughly calculating the amount of lead, on improvised instruments. To get a satisfactory percentage of hits with machine guns, it has been found necessary to use accurate fire-control instruments similar to those used for directing the fire of the three-inch gun.

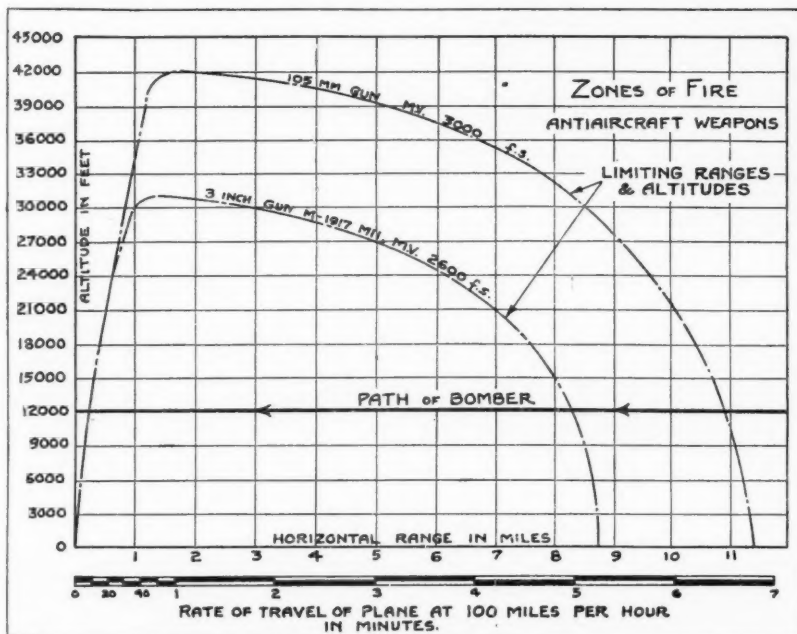
A new anti-aircraft weapon of great promise is the 37-millimeter, full automatic gun, firing about 90 one and one-fourth-pound projectiles per minute per gun. This shell is equipped with a special fuse to operate on contact with any part of the airplane, and a single hit with this weapon may destroy a wing or other vital part of the airplane.

From the advance which has already been made in anti-aircraft fire, it is



DUSTY ACTION

Rapid firing of 105-millimeter anti-aircraft gun causes much dust due to concussion

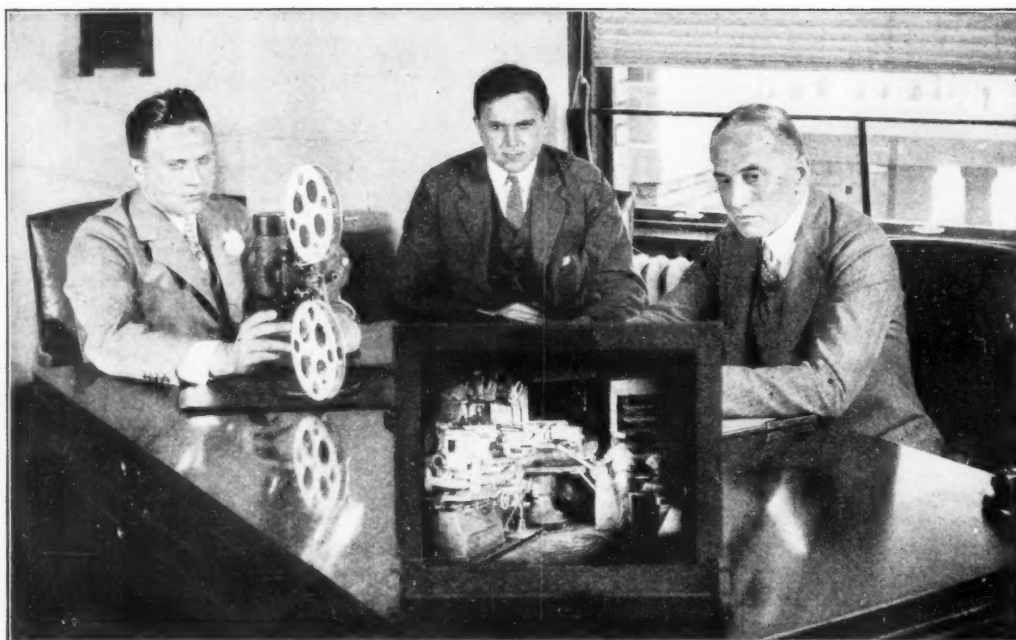


VERTICAL AND HORIZONTAL ZONES OF FIRE

The 105-millimeter gun can throw a projectile to a height of over seven miles and, horizontally, over 11 miles; the three-inch gun nearly six, and nearly nine miles, respectively

safe to predict that anti-aircraft weapons of all types will become more and more effective as time passes.

The writer does not contend that the airplane will be unable to take to the air due to artillery fire. Field artillery can now successfully destroy infantry, but under certain conditions the infantry advances. However, the prevalent idea that the airplane will, in future wars, ride roughshod over all existing defenses unscathed will, as years go by, be forgotten, and the airplane, like the submarine, the tank, and the gun, will take its place as an important auxiliary tool in the complicated and ever-changing machinery of war.



THE EXECUTIVE'S DESK BECOMES A STAGE

An up-to-date salesman equipped with industrial films, a portable projector, and a "daylight screen" demonstrat-

ing his wares on the mahogany desk in his prospective customer's office, showing one scene from the picture

Putting It Over With "Movies"

Advertisers Adopt the Use of Motion Pictures to Promote Good Will, "Educate" Prospective Clients, and Sell "Hard-to-Advertise" Products and Service

By HENRY W. HOUGH

BUSY executives, street loiterers, housewives, and casual theatergoers are now finding themselves recipients of the attentions of advertising men who "put over" their message in an unusually pleasant form. Most people still consider "movies" as a rather pleasant diversion. This fact, aided by the rapid development of portable projectors, daylight screens, and a wide variety of well filmed industrial motion pictures, has created a new era in advertising. The public is now being "entertained" with the carefully prepared and often costly creations of enterprising business and industrial leaders.

Broadway's most regal "movie" palaces have recently presented some outstanding pictures of this type, produced by Visugraphic Pictures, Inc., for the New York Stock Exchange, the Radio Corporation of America, the New York Edison Company, and other prominent firms. What is good enough for Broadway is good enough for Main Street, and most of the theater-goers of the nation will eventually see these pictures in

their own local motion-picture theaters.

There are about 21,000 moving picture theaters in the country, and more than 65,000 non-theatrical exhibitors of motion pictures, all of which present a potential market for well produced industrial "movies," especially if there seems to be unusual educational value to the films. Incidentally, it has been computed recently that there are in this country about 100,000 homes equipped for exhibiting the smaller size or 16-millimeter films.

INDUSTRIAL films are classed by their producers as selling, technical, propaganda, and educational pictures. In addition to these there are the object lesson pictures of the type produced by the United States Bureau of Mines for instructing employees in first aid and safety measures.

Many business firms are using "movies" of the 16-millimeter size to exhibit their products or service. Anyone can take such pictures, and this type of display, with portable projecting apparatus, is particularly popular at conventions, in lobbies and store windows, and for demonstrations

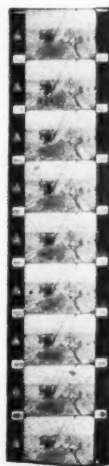
in the home or office of a prospective client. "Hard to advertise" subjects, such as heavy machinery or intricate processes, are very effectively portrayed in a single reel of inexpensive film.

An example of this type of industrial movie was seen in the booth of the Wailes Dove-Hermiston Corporation at several recent conventions. This firm had a capable amateur take moving pictures of the construction of the 340 mile pipeline that now carries natural gas from Amarillo, Texas, to Denver, Colorado. The film showed

16-MILLIMETER FILM

Strip of film from an advertising "movie" showing actual size of the 16-millimeter film widely used by amateurs for producing industrial pictures

the variety of field conditions along the line, and clearly exhibited the method used in applying hot Bitumastic enamel as protection against corrosion, just before laying the pipe in



position on the floor of the trench.

When an advertiser intends to use industrial "movies" for wider distribution, the standard size film (35 millimeter) is usually used. Almost all amateur motion pictures are taken on 16-millimeter film of a type that is developed by the "reversal" process, rather than by making duplicate "prints" from the original negative. At least one manufacturer makes 16-millimeter film from which any number of "prints" can be produced, but for the more pretentious industrial "movies" the larger size is used almost exclusively.

Of course the use of duplicate prints makes possible much wider distribution of the films, particularly in view of the fact that theaters and most of the non-theatrical exhibitors are equipped with projectors designed for 35 millimeter film.

FOR these more costly productions it is customary to engage a firm or agency making a business of producing industrial moving pictures. Since those paying for the "movies" are thinking of the investment in terms of advertising value, the cost of the production is of small consequence. For this reason, industrial "movies" are now made with the technical skill and attention to settings that one expects of regular commercial moving pictures, or "features."

The film, "The Nation's Market Place," produced by Visugraphic Pictures, Inc., for the New York Stock Exchange, cost about 15,000 dollars and entailed almost insurmountable obstacles inasmuch as it was taken on the floor of the Exchange during a customary session. This picture runs in about fifteen minutes, and has already been seen by more than 5,000,000 people.

Another Visugraphic picture that has "played" at Roxy's and other theaters on Broadway, as well as on

countless minor "Broadways," is the film "Man Made Miracles," showing how radio tubes are made in the factory of the Radio Corporation of America. This film has a number of interesting features, aside from the story it tells. By showing certain processes in "slow motion," the lightning-like movements of certain operators can be analyzed, showing the value of slow motion pictures for research and improved practice in industry. In order to show flame in color in certain scenes, it was necessary to paint in the colors on each exposure—painstaking work, and expensive. The captions or sub-titles of several prints of the films have been translated into Spanish for exhibition in Spain during the Barcelona Exposition, and in various countries in South and Central America.



FAST WORK IN "SLOW MOTION"

Lightning-like movements of skilled workers are analyzed and studied by reproducing in "slow motion"

The United States Government, through the Bureau of Mines, of the Department of Commerce, is one of the largest producers of industrial moving pictures. The "government pictures," as they are known to exhibitors, are paid for by the particular corporation that co-operates with the Bureau of Mines in making the film. More than one million dollars has been appropriated by the mineral and allied industries to carry on this work.

"The preparation of the scenarios for these films, as well as the actual production of them, is supervised by engineers of this bureau," according to M. F. Leopold, Supervising Engineer in charge of the Motion Picture Production Section of the Bureau of Mines. "The entire cost incidental to the



BULLS, BEARS, AND PAGES AS ACTORS

A "still" from the Visugraphic Stock Exchange film "The Nation's Market Place," a favorite on Broadway

actual production of a picture and that of providing a sufficient number of copies for circulation, is paid for in each instance by the co-operating agency.

"In the production of these films we do not permit any trademark, tradename, or any other material which may be construed as advertising to appear in any part of the picture. In addition to the government title which appears on these films, there also appears a short courtesy title giving the name of the co-operating agency."

AMONG the firms using moving pictures for promotion and educational work, either in co-operation with the Bureau of Mines or by arrangement with commercial producers of industrial "movies," the following organizations and their films are particularly noteworthy:

National Coal Operators Association, "The Story of Coal"; Westinghouse Electric Company, "Water Power"; United States Steel Corporation, "The Story of Steel"; American Petroleum Institute, "The Story of Petroleum"; and films of the American Gas Association, H. L. Doherty and Company, General Electric Company, Buffalo Evening News, Metropolitan Life Insurance Company, the United Press Associations, and the Government of Chile.

Arrangements were made recently with the Theater Owners Association of Quebec for exhibiting one of the Bureau of Mines safety films, "Carbon Monoxide—the Unseen Danger," in the 147 theaters of the Association. The Japanese government has purchased four of the Bureau of Mines films for use in conjunction with a general safety campaign in that country.

At the present time all classes of industrial motion pictures are furnished gratis to exhibitors in this country, it being understood that the exhibitor is to pay all handling charges.



CONVINCING THE HOUSEWIFE

Enterprising salesmen find that housewives have time to witness advertising "movies" in the home



SITE OF THE FIND

The author pointing to the hole in the bank. No artifacts were found there

IN August, 1927, I read an article in the *SCIENTIFIC AMERICAN* which described the discovery of evidences of prehistoric man in the southwest. It then occurred to me that such evidences might also be found in the locality of Abilene, Texas, where I reside. An intensive search was begun, which has since used up the time of my available holidays.

Prior to this time it had been the general opinion that evidences of primitive man were scarce in this section. The contrary was found to be true. Within the short period of a few months I have collected thousands of stone artifacts which vary greatly in form and type, as well as chemical alteration or patination.

SOON after the search was started, a fossil skull having primitive features, also two fossil beads, were discovered. In addition, portions of thick skull plates were found where they had been left exposed by deep holes which the wind had blown into the local sand-dune land. These and other evidences of ancient camp sites were always found in sand-dune land near springs or where springs possibly had been in the past, but in situations now located several miles from water.

One flat frontal bone, having heavy, beeting supra-orbital ridges, previously taken from this culture, is owned by Simmons University. A photograph of this was obtained through the kindness of Prof. D. W. Arnett of that institution, and is reproduced in the present article.

With the encouragement provided by this fossil, the hope persisted that a complete skull of the same flat-headed type might eventually be found.

New Evidences of Ancient Man in America

Unusual Skeletal Remains Recently Discovered in Texas Suggest Further Investigation Before the Hypothesis of Ancient Man in America Is Abandoned

By DR. CYRUS N. RAY

President, Archeological and Paleontological Society of Texas

While at the Lamb's Head Ranch, owned by Mr. J. A. Matthews of Albany, Texas, I met a cowboy, Mr. Bob Bradford, who told me of some bones which were protruding from the side of a high bank over the Brazos River.

On arrival at the site we found a

taken of the color and texture of the soil of the six horizontally laid strata above the grave. In the latter, the stratification was perfect, showing different colored layers which had not been broken through or disturbed. Number 1, the uppermost, was composed of six inches of top soil humus having a chocolate color. Number 2 was composed of 15 inches of reddish-brown clay loam; Number 3 was of five inches of chocolate colored clay loam; Number 4 was of 11 inches of sandy loam of light tan color; Number



ONE OF THE SKULLS

The vault is low and the eyebrow ridges pronounced, but the chin is prominent

steeply sloping bank 40 feet high. Below a depth of five feet, ten inches from the top soil, three large, flat limestone rocks were seen to be slightly projecting from the bank. Two of these stones lay flat on either side and the third lay over the space between them. From this middle space projected the upper ends of two human femur bones. The soil had been disturbed but a few inches over the bones, as though a shallow burial had been made and then later the 70 inches of soil had been stratified over them.

Before removing the bones, a sketch of the position was made. Notes were



THE OTHER SKULL

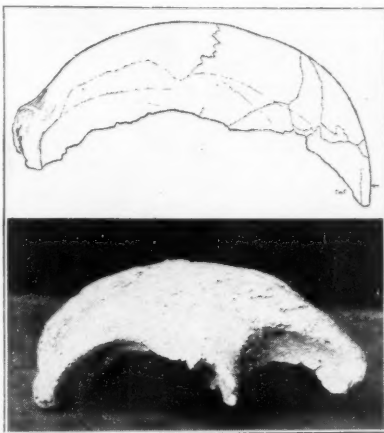
This was deformed by the weight of a superincumbent rock. Note heavy eyebrow ridges on both of the crania

5 was of 13 inches of dark brown clay loam; and Number 6 was of 33 inches of sandy clay loam of light tan color.

The burial was in the last 13 inches of the last named layer, Number 6. The bank where the burial was made faces the east. The body had been folded together at the hips, jack-knife fashion. The excavation began at the hips and as we dug in from the east we found the thigh and leg bones and forearm bones on the south and the pelvic fragments and lumbar vertebrae on the north. Farther in on the north, were found the lower dorsal vertebrae and many rib fragments.

All of these bones were found under the first three large rocks which had been seen projecting. Three more large rocks, lying in the same relative positions, were next removed. Under these were found parts of the upper dorsal vertebrae, most of the cervical vertebrae, both collar bones perfectly preserved and parts of the scapulae and ribs.

Under the large, flat, middle stone was found a complete skull and lower jaw with all the teeth. This skull was lying flat under the stone which had crushed it. The vault of the skull had parted in the center and the right side had been thrust up, overlapping the left or lower side. This side-flattened, crushed condition gives the pictures of the skull an apparent added height which is the result of distortion. If



TWO SIMILAR CALVARIA

Above: from Clear Creek, Arkansas; courtesy of *Science*. Below: frontal bone at Simmons University, Abilene, Texas

restored to its original outlines, this skull would be as flat on top as the other one. The skull was cleaned on the outside, leaving the clay matrix inside to hold it together, as found.

About five feet away, in the same stratum, rib bones were seen to be projecting. At this place the almost vertical face of the bank had caved off on either side, leaving a narrow mass of projecting, stratified soil in the center. Below this, lying far down the steep bank, were six large, flat rocks

similar to those taken from the first grave. Between these were also some rib fragments which had dropped from above. Evidently these stones had slid down from a cave-off of another burial.

On digging into the shoulder of remaining stratified soil, many fragments of vertebrae, ribs, and leg bones were found. Also, farther in the bank an almost complete skull top with a complete lower jaw and teeth were discovered. This lower jaw, like the other one, is of massive construction with heavy teeth. Both jaws have chins and both have small mental tubercles.

The tops of both skulls are decidedly flat; in fact these people had very little skull space above the eyebrow level. The skull bones of both are unusually thick. This is also the case with the long bones.

The radius and other long bones have some peculiar curvatures which

An Unknown Race?

WHETHER the author of the accompanying announcement has discovered evidence which may establish the existence of a hitherto unknown type of early man in America, can be decided only by the professional anthropologist. Certain characteristics of the crania have suggested to him Neanderthaloid affinities, as stated in private letters to this journal. However, he has resisted the not unnatural temptation to publish such a startling claim. It is nevertheless possible, as Keith, the anthropologist, states, that there have been many more races of man in the past than we now know of. —The Editor.

may be noted in the pictures. I wish to call attention to the articular faces at the knee joints. A cross section of the shin bone or tibia, taken at about the middle of the shaft, shows a much flattened outline instead of the modern triangular one.

Of the skeletons two humerus bones were found whole, three clavicles are complete and several cervical vertebrae almost so. Enough of the shafts and the articular facets of both ends of both the femur and tibia were found to reconstruct both bones. One radius is complete, three patellas are intact. Most of the bones of a foot were preserved, including some small terminal phalanges. The bones of both skeletons are mineralized or petrified. Some are quite heavy and hard and give out a resonant clink when knocked together.

Mr. J. A. Matthews has lived near the place where the bones were found, since 1852. He stated that in that period the river had been out of its high banks five times, once in 1876,



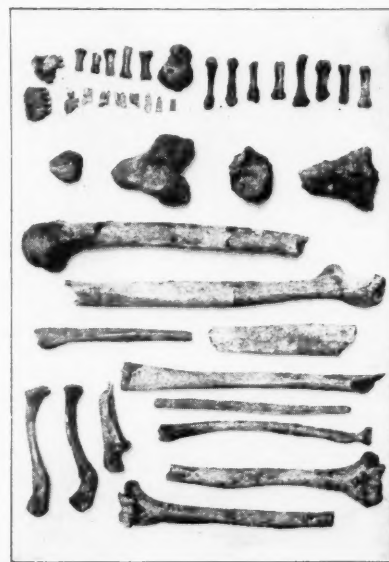
LONG BONES

Two humeri; two tibiae; femur. These and others show various aberrant tendencies. One joint has been chalked

twice in July 1895, once in 1900 and once in 1922. The ground where the burial was made is much higher than that back of it for a considerable distance. In fact, it is one of the highest points close to the stream along that portion of the river. Considering the infrequent intervals indicated when overflows have occurred, it must have taken a long period of time to lay down the strata of soil over these burials. The same strata are exposed over a distance of 100 yards or more.

In another place a layer of small stones and shells in the burial stratum may or may not indicate a former camp site. In a gravel stratum about 25 or 30 feet lower, were found the mineralized skeletons of two large animals.

I believe this general region should be studied by those seeking evidences of primitive man in America, and professional anthropologists are invited to come here and see the mass of evidence that has been accumulated, and to visit the sites where the objects have been found.



TEETH AND TIBIAE

A cross-section of the tibia does not correspond with any shown by Keith

Scientific Examination of Paintings

Mute Evidences of Authenticity Yield Their Testimony to the Skilled Scrutiny of the Scientist

By FRANCIS P. MANN

THE question of the authenticity of works of art is of the greatest importance. In the last 25 years the values of paintings in particular have become greatly enhanced and canvases worth half a million or more are constantly changing hands. Just recently we have witnessed the trial of a celebrated and titled dealer who was sued for 500,000 dollars for "slandering" a painting nine years ago. The public showed so much interest in this suit, which occupied columns of space in the newspapers, that possibly our readers would like to know how a painting is examined and, in a later article, how fraud may be guarded against.

The picture of today may be the museum piece of tomorrow. Formerly, the expert examined a picture by the unaided eye, or it was thought enough to make a photographic enlargement of the picture. But at the present time, pictures are put through an examination in the laboratory, in which many of the resources of science are called into play.

IN order to show what can be done in the way of identifying pictures, we will give a brief account of the examination of a supposed Raphael which was carried out in Paris by a leading scientific expert, Mr. Edmond Bayle, Director of the Judicial Identity Department, aided by Messrs. Henri George and Augustin Maché.

The picture was painted on a wood panel, and, as shown in our photograph, it represents the Virgin and Child, with two angels. Its height is about two feet, six inches. The upper garment of the Virgin is red, and the lower garment blue. The angel on the left has a blue tunic with green sleeves, and a robe of a blue-violet color; the one on the right has a blue tunic with pink sleeves and a green robe. The picture is signed and dated: Raphael Urbinas F MDIII. The "F" stands for "fecit."

To properly examine the wood of the panel, the experts took off small splinters from the backs of the boards composing the panel and then made sections for microscopic examination. This shows the structure of the wood. They also made a microchemical test to show the nature and the present condition of the cells. They found that the boards all belong to the same species, *Cedrela odorata*, and that they are all of the same age, several hundred

years old, a valuable fact in itself.

Cedrela odorata is a variety of mahogany which was well known at the time of Raphael and was obtained from India through the Mediterranean ports. It was used principally in Italy and Spain for high-class construction, and it is well adapted for artists' use, as it has a fine grain and is hardly attacked by insects.

The drawings at the bottom of the opposite page show the structure of the old wood as compared with recent wood of the same kind. The age of the wood is apparent from the shape and the general arrangement of the cells, and



QUESTIONED PAINTING

This is the example cited in the text for the explanation of the methods employed

especially the appearance of the cells, as well as their chemical state. It will be noticed that the cells of the old wood have shrunk and the walls have fallen in, so that they have lost their geometrical form. Due to the slow action of time, the veins have separated from the surrounding part and appear isolated.

When examining any sample of wood of a known age, it is observed that the action of time is continuous, and that for a given variety of wood, the same value of alteration corresponds to the same age, so that in the present case, several centuries have elapsed since the tree was cut.

At what time was the panel made? The experts found that the wood was

in a well-dried, unused state, when the panel was put together. In fact it is shown by X-ray examination that the boards were assembled by simply glueing the edges, and the wood must have been perfectly dry at the time, or else it would not have remained in place. From what is known about the drying of wood, they estimated that the wood was at least 50 years old when the panel was made up.

Another point is that there were quite a number of worm holes in the panel. These holes are perfectly circular, and prove that the panel had been put together when the wood was first attacked by the worms; that is, the panel was made of newly trimmed boards, because when we cut up old wood that is already worm-eaten, we necessarily cut at angles across the cylindrical holes made in all directions through the wood.

IT was found that the wood had been covered with a layer of paint before it was attacked by worms. There are no holes at the level of the painted surface, as an X-ray examination showed. On the fluorescent screen the holes appear as small bright points.

Turning to the question of the painting itself, it is to be asked whether the picture we see now is the one that was originally put on; that is, whether the experts had to do with an old panel covered with an old layer of paint, on which a picture had been painted at a recent date. A flake of the white backing layer of the visible painting was taken off by a needle point, and this was put through a spectroscopic examination. The back part of the coating is found to be calcium, and this is in conformity to the old practice in which lime was used for the backing layer.

The character of the painting was next examined. Small cotton wads soaked with alcohol were rubbed over the painting, thus removing a microscopic amount of the pigments, which was enough for an examination.

It was found that the blue color of the Virgin's principal garment contains "lapis lazuli" (or mineral ultra-marine blue) and not artificial ultra-marine blue. But lapis lazuli as a pigment has been obsolete for a long time. Even in Raphael's time it was sold for its weight in gold; in fact, gold was used as the actual weight on the scales, the color being enclosed in small quills. The ultra-marine color was conse-

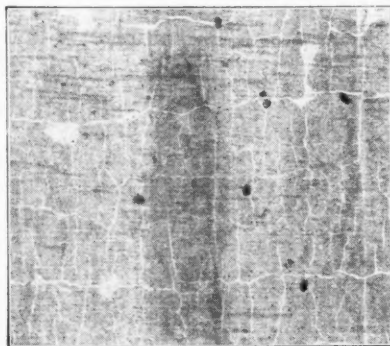
crated to the Virgin, and in view of its high price, it was customary for the client to furnish the painter with a suitable amount of the ultra-marine when ordering a picture dedicated to the Virgin Mary. However, in this garment there is mixed with the ultra-marine blue a pigment which consists simply of indigo, which tends to show that the artist was too scantily provided with the fine color and had to eke it out, as was often done, with an inferior color. In the upper garment, mercury was found; the polariscope shows that the pigment has the crystalline form, so that cinnabar is the color here used, as was customary with the old masters.

THEN the picture was examined in the dark by ultra-violet rays, and the experts saw, contrary to what was expected, that the picture was slightly and uniformly lighted, each part keeping its own color. This can only be explained by the presence of a uniform layer of a fluorescent varnish, which thus indirectly lights the whole subject. This fluorescent layer could not be removed without risk of damaging the picture itself, and this therefore means that the layer is intimately incorporated with the substance of the picture. Now, the experimenters were familiar with old paintings of various epochs in this respect, and concluded that the effect could only have been produced by a very long action of time. Hence, the age of the picture became still more evident.

Further characteristics of ageing were then examined. The natural cracking of a picture is due to the action of time, and the aspect of the cracked surface varies according to the use of varnish as a drying oil. Oil itself has peculiar cracks which vary with its nature, and as a rule the cracks will vary with the process used by the artist, who employed one or another vehicle for grinding up his colors and in mixing them on the palette. The old masters' paintings showed cracks which are peculiar to them. Also, it is one of the new ideas to show that the

cracks vary with the backing, and are different according to the use of wood or stretched canvas. The depth of the cracks also increases with the time.

All this will show the importance of the study of the cracks and why the imitators take so much pains to imitate them. To fake a whole set of cracks on a picture, it is the custom to trace them off the real picture and then



CRACKS TESTIFY

The fact that the system of cracks extend through the brush stroke of the signature (dark stripe in the center of this X-ray view) indicates the painting's authenticity

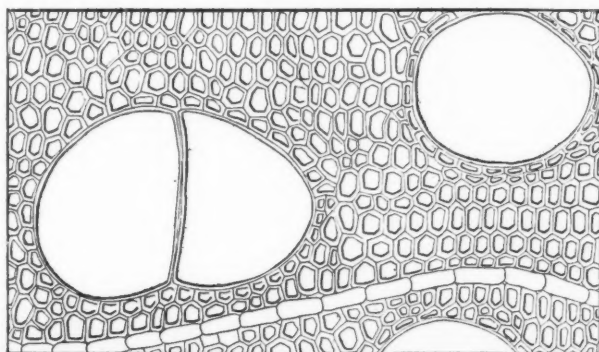
transfer them to the painting itself, which is first prepared by making small pin scratches upon it. Then the picture is heated in an oven to the proper temperature, thus producing deep cracks on the lines which have been marked out or started by the pin scratches, and these have the appearance of the natural cracks. By an X-ray examination it was shown that the large veins or knots in the wood will affect the general arrangement of the cracks. In the present picture, each vein of the wood is seen to correspond to a change in the aspect of the cracks, so that these cracks must necessarily be considered as genuine.

Next came the age of the successive restorations. This point can be well determined by an X-ray examination. As already observed, depth of the cracks depends upon the age of the painting. Under the X ray, the cracks appear as small lines which are sharper

and clearer as the cracks are deeper. To compare the two crackled parts as to their depth, the tonality of a given region is compared. This examination clearly shows the position and the limits of the restorations, which have a general lighter aspect than the original painting. If it is considered that all cracks are shown up by photography, while in the case of the X rays the visibility of the cracks varies according to their depth, it is found—and this is a recent discovery—that the simultaneous examination by photography and radiography will afford exact data as to the age of the different parts of the painting. This, of course, applies principally to restorations. The authorities found that the painting had been restored at different periods, and this is a point in its favor.

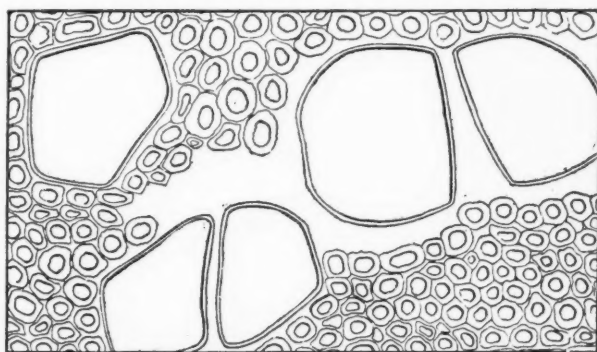
NO painted subject was found underneath the present picture, nor was there any alteration of the character of the painting by improper retouching. To sum up the results of the whole investigation which bore upon many other points that we are obliged to omit, it was shown that the painting had all the character and the peculiar features, as well as the age of the old masters, and the period which may be assigned to it corresponds very well to the age which was found for the wood panel itself. Everything, therefore, points to the authenticity of the picture, as to age and physical aspects.

Modern expert examination of paintings considers the following major questions: First, with canvas the nature of the fiber and its impurities, or the nature of the wood panel if the subject be painted on wood; second, the basic coating on the canvas or panel; third, the mineral matter in such coatings. Then when the artist comes on the scene, we can examine the nature of the pigments which the painter used. Strange to say, quite a bit of information has come down to us on this subject in printed form. Great attention is paid to the possibility of another picture being underneath, as well as to restorations, wise or unwise.



NEW *CEDRELA ODORATA*

The cells of the wood are in their pristine state, and are closely grouped around veins (large openings). See drawing at right



OLD *CEDRELA ODORATA*

The cells have shrunk and lost their original formation. They have also separated from the larger veins. Compare with drawing at left



PACIFIC TYPE LOCOMOTIVE EQUIPPED WITH CONTROL APPARATUS

The engineer who is alert can retain control of this locomotive by responding properly to signals. If he does not respond to a "stop" or "slow" warning of the block signal system, his train stops. A "clear" signal necessitates no action on his part. Note location of reset

Is The Engineer Alert?

Train Control Apparatus Stops Train Automatically if for Any Reason the Engineer Fails to Respond to Signals

ALTHOUGH our railroads are running with an ever-increasing factor of safety due to greater operating efficiency in many respects, we hear from time to time of a railroad accident, the cause of which is laid to failure of the engineer to respond to signals and control his train properly. Practically all railroads of any consequence in this country are equipped with automatic block signal systems which, besides allowing speedier and more efficient service, serve to promote safety to a degree that might be perfect were it not for the fact that the human element still enters into the question. The possibility, remote though it may be, of an engineer failing to control his train due to mental aberration, illness, or sudden death has focused attention for many years on the vital question of automatic control of trains.

THE first attempts to devise a method of controlling train movements through the medium of wayside apparatus can be traced as far back as 1859. But all the elements required for such control were lacking until the invention of the air-brake in 1869 and of the closed circuit for block signals about a year later. Even then, years of laborious evolution for both these devices were required before train control became practicable.

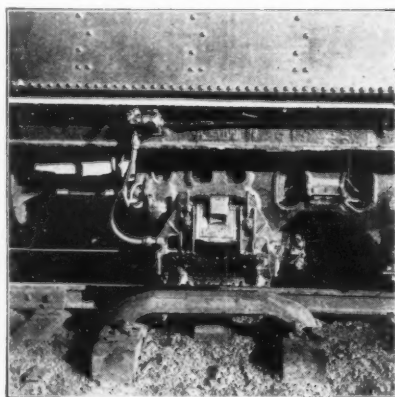
In addition to hosts of amateur and independent inventors, a number of railroads devoted a great deal of energy and considerable sums of money

to attempts to find and develop a successful automatic train control device. Conspicuous among these was the New York Central Railroad, which appointed a committee in 1904 to study and experiment with automatic train control. This was two years before Congress took cognizance of the subject by legislative action and 18 years before the will of Congress was formulated in a specific order by the Interstate Commerce Commission to make the first installations. Not until then had ideas on automatic train control crystallized sufficiently even to hold out a hope of success.

The committee, in the course of its work, found that not less than 3600 patents had been issued for train

control devices. It painstakingly examined these and found nine devices that seemed worthy of trial. These nine were tested exhaustively in actual operation, but it was determined that none of them had been developed sufficiently to warrant adoption. Finally, after further experiments and development work the committee decided that the device best suited for the conditions prevailing on the New York Central lines was the General Railway Signal Company's intermittent, inductive, automanual type automatic train control, which superimposes upon the fixed signal system already in operation a rolling signal system which offers additional safeguards. This rolling signal system is now in use on the main line of the New York Central between Croton-on-Hudson, New York, and Englewood, on the outskirts of Chicago, the longest stretch of main line so protected in the United States, if not in the world. Large stretches of main line track on other New York Central lines likewise are protected by train control.

THE object to be attained by train control is to enforce obedience of the automatic block signals with which the lines have long been equipped. The train control is connected with the block signal system and is a part of it, so that there is no chance for disagreement between wayside signals and train control regarding whether a train should stop or proceed.



RECEIVER AND INDUCTOR

Intermittent inductive train stop receiver on tender journal; inductor is on the ties

If the engineer fails to observe and obey the block signals, the train control apparatus brings the train to a stop. It cannot proceed until some one steps down from the engine to the ground and moves a lever which allows the brakes to be released.

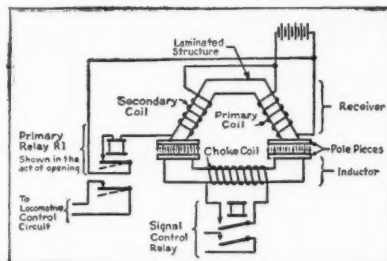
Apparatus by which this is accomplished is in two parts: one on the locomotive, the other attached to the track in the rear of the automatic block signal with which it operates.

THE part attached to the locomotive, designated as the "receiver," is attached to a journal box on the tender. It consists of an inverted U-shaped magnet with laminated cores, large pole pieces, and two coils. The primary coil of the receiver is constantly energized from the turbo-generator which supplies current for the headlight and cab lights on the engine, producing a strong magnetic field. The secondary coil is connected with the same circuit and also with a relay through which a small current flows normally.

The track element, which is called an "inductor," is similar to that on the locomotive. It is attached to special cross-ties with its pole face two and one half inches above the top of the rail and its inner vertical face about 17 inches from the rail. It is protected

until he can reach the reset button on the rear of the tender. This he must do from the ground.

The primary purpose of automatic train control is to compel obedience to the automatic signals. The engineer, when approaching a signal which indicates that he must stop or slow up, will acknowledge the signal by operating a "forestalling" lever which is located in the cab. He holds this lever down until an acknowledging whistle informs him that the inductor has been passed. If this lever were held longer than 15 seconds, the brakes would be



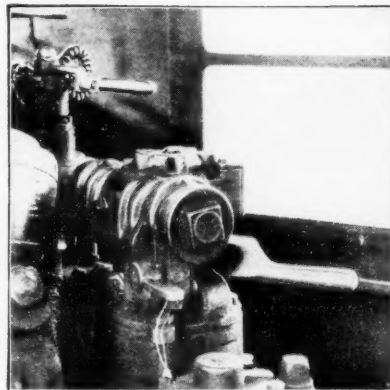
HOW IT WORKS

Wiring diagram illustrating the principle of the control system described in the text

applied automatically. The underlying principle is that by his acknowledgment the engineman has shown that he is alert and in full control of his train.

So long as the road is clear for two blocks ahead of a moving train the semaphore blades of the block signals point toward the zenith, or a green light is displayed. This indicates to the engineman that he is expected to proceed at the proper speed.

But if the semaphore blade is at an



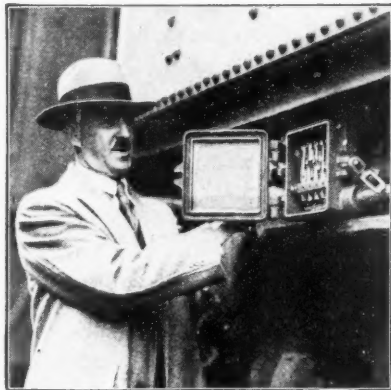
BRAKE ACTUATOR

Attached to the cab brake valve, this device is controlled electro-pneumatically

angle of 45 degrees, or if a yellow light is displayed, it is a warning to reduce speed so as to be able to stop just before reaching the next signal unless it changes to yellow or green as the locomotive approaches, in which case the train proceeds.

In other words the New York Central main lines will not be mechanically operated. Its trains will continue to be run by experienced men whose vigilance will be supplemented by a marvelous apparatus, ever ready to act in an emergency, if for any reason, the engineman should be unable to perform his duties.

Several other railroads in the United States installed similar train control systems before the original order of the Interstate Commerce Commission made it compulsory. These and other roads are rapidly extending their train control systems.



THE RESET CONTACTOR

When the train has been stopped by the automatic apparatus, this must be reset

by a non-magnetic housing. The inductors have a choke coil automatically controlled so that while the signal with which it is connected is at clear, the coil is closed on itself. When the receiver on a passing locomotive approaches an inductor having an open circuit—that is when the signal indicates "caution"—a magnetic flux builds up in the secondary coil producing a current in the receiver which causes the relay to open and apply the brakes through an electro-pneumatic device attached to the engineman's brake valve. Once the relay opens, the engineer cannot prevent his train from stopping and cannot reset the device



FOUR TRACK MAIN LINE SHOWING INDUCTORS

Semaphores on the two right hand tracks show "stop." If the engineer does not hold his forestaller lever as he approaches, his brakes will be set automatically and his train will stop

Solar Research for Amateurs—II

How to Construct the Spectrohelioscope, Which Reveals Solar Phenomena In Actual Motion

By GEORGE ELLERY HALE, Sc.D.

Honorary Director, Mount Wilson Observatory of the Carnegie Institution

(Concluded from April)

AS explained in the last article, some of the most spectacular and beautiful phenomena in the heavens are visible daily in the solar atmosphere. These have so recently become accessible to visual observation that they are but little known, and thus offer promising opportunities for discovery to amateur astronomers. The purpose of this article is to explain the construction of the simple instruments necessary to observe them.

The telescope required is of the coelostat type, giving a fixed solar image two inches in diameter for study with a spectrohelioscope.

The coelostat consists of a plane mirror of plate glass, five and one half inches in diameter and one half inch thick, mounted with its surface parallel to the Earth's axis and uniformly rotated by an ordinary (two dollar) clock movement at the rate of one complete revolution in 48 hours. The front surfaces of the coelostat and second mirrors should be plane to about one quarter of a wavelength.

A COELOSTAT (in which the plane of the mirror is parallel to the polar axis) is recommended in this article, instead of a heliostat, chiefly because it gives a solar image which does not rotate during observation. The rotation of the image obtained with a heliostat is slow, however, and the only difficulty it involves in visual observations is the necessity of re-determining the orientation from time to time, in case the heliographic positions of the prominences or flocculi are to be recorded. The simplest possible substitute for a coelostat or two-mirror heliostat is a polar heliostat, which is merely a polar axis carrying within a fork a single mirror, which sends the sunlight upward or downward through a lens toward the north or south pole. In this case (unless a second mirror is used) the spectrohelioscope must be mounted in a plane parallel to the Earth's axis.

The parallel rays of sunlight reflected from the silvered front surface of the coelostat mirror fall on a second mirror of plate glass, four and one half inches in diameter and one half inch thick, mounted in a fork, and provided with slow-motion screws controlled by the observer with rods or cords. This

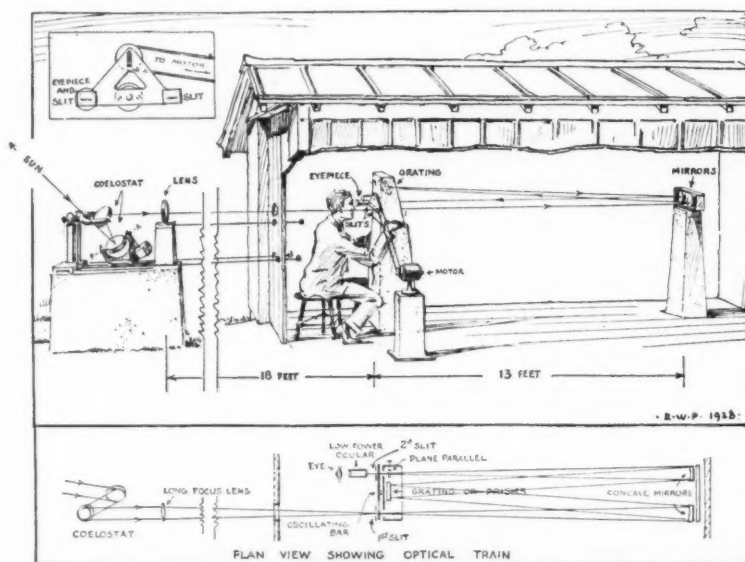
mirror is fixed during observation, but the slow motions permit the observer to move it sufficiently to bring any point on the Sun's disk or circumference to the center of the slit of the spectrohelioscope.

These two mirrors, of course, do not form an image of the Sun. They serve merely to send the parallel rays in a chosen direction (usually north) and to hold them there during observation. The solar image is formed by a single plano-convex lens three or four inches in diameter and of 18 feet focal length, mounted on a support which can be moved north or south with a coarse screw by the observer for focusing the image on the slit. Such a lens is suitable only for observations with monochromatic light. An achromatic lens is needed for direct observations of sun-spots in white light. A small telescope having an achromatic lens one or two inches in diameter, with eyepiece permitting a solar image from four to six inches in diameter to be projected upon a white card for recording the positions of sun-spots, will serve as a useful auxiliary. The larger spots can be fairly well seen, however, on the two-inch image given by the single lens, especially if it is looked at on a white card through dark spectacles, supplemented by a piece of red glass to eliminate other colors.

The coelostat, second mirror, and lens are shown on page 437, mounted on a wooden tripod south of a small garage containing the spectrohelioscope. For permanent use a brick or concrete pier, covered with a small wooden house easily removable when observations are to be made, should be erected as a more stable base. The coelostat may stand either east or west of the second mirror support (out of its shadow), but on account of the varying altitude of the Sun, it must be moved north or south and fixed for any given date at a point where the reflected beam falls on the center of the second mirror. The beam is then maintained in place by the driving clock.

THE spectrohelioscope is merely a long-focus spectroscope, provided with a pair of rapidly oscillating slits affording a view of a portion of the Sun's atmosphere in the monochromatic light of the red hydrogen line known as *H α* . It gives such an image of the Sun as might be obtained through a red screen (if such could be made), transmitting no light except that due to this hydrogen line.

An ordinary spectroscope consists of a narrow slit, a (collimating) lens for making the divergent rays from the slit parallel, a grating (or one or more prisms), and a second lens for forming



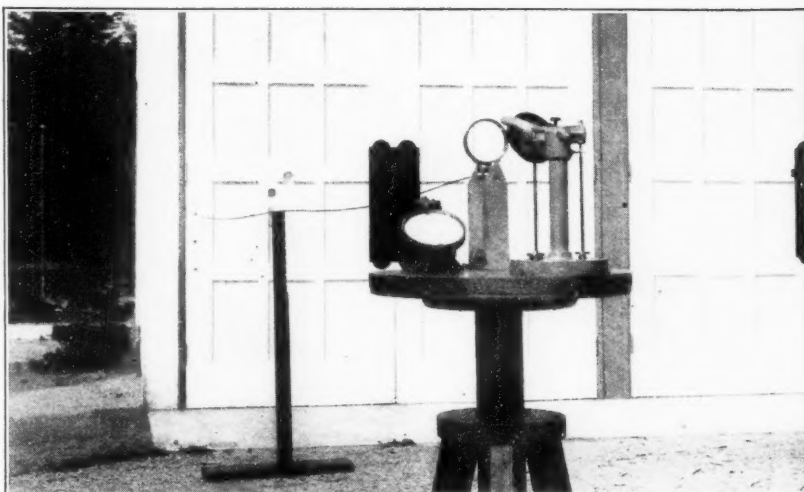
SOLAR TELESCOPE AND SPECTROHELIOSCOPE

This shows clearly the path of the rays used in forming a red (*H α*) hydrogen image of a part of the solar atmosphere. From a special drawing by Russell W. Porter

an image of the spectrum, which is examined by the observer with an eyepiece. The grating is a plane surface of polished speculum metal, on which about 15,000 lines per inch are ruled with a diamond. This diffracts the incident light, and produces a number of spectra resembling those given by prisms.

In the present instrument two spherical concave mirrors, of two inches aperture and 13 feet focal length, mounted upon a single support permitting them to be focused by a screw, are used in place of lenses. Light from the solar image falls upon the collimating mirror 13 feet away, and is returned (by a slight inclination of the mirror) to the grating or prisms mounted behind and above the slits. The red ($H\alpha$) region of the spectrum thus formed, falling upon the second concave mirror, is reflected to a sharp focus at a point near the first slit. Here it falls upon a second slit, adjusted so as to coincide with the center of the $H\alpha$ line.

THE operation of the instrument will now be evident. If the first slit, on which the solar image is focused, is moved in the plane of dispersion, the spectrum will move a corresponding distance. To remain on the line, the second slit must be displaced accordingly. The first and second slits are therefore carried at the opposite ends of a very light metallic bar, mounted on a bearing halfway between them. This bar is oscillated rapidly by a small electric motor, through an amplitude (usually about a quarter of an inch) which is limited by the brightness of the spectrum. The observer, looking through the oscillating second slit, which remains exactly on the $H\alpha$ line, sees by persistence of vision a hydrogen image of a portion of the Sun. This may include a part of the limb, where a prominence appears bright against the



SMALL SOLAR TELESCOPE USED

The coelostat mirror at the left, driven by clockwork, reflects the sunlight to the second mirror which is provided with slow-motion screws for directing the solar image. This is formed by the simple lens or collimator (center), adjustable by a screw for focusing the image on the slit of the spectroheliograph 18 feet away, within the building. Note small opening

sky, and at the same time a part of the disk, upon which a portion of the same prominence may extend as a dark flocculus.

High velocities in the line of sight produce distortions of the $H\alpha$ line, toward the violet when the gas is approaching, toward the red when it is receding. To see a mass of hydrogen receding at a velocity of, say, sixty kilometers a second the second slit must be set, not on the normal position of the $H\alpha$ line, but at a position completely outside of it toward the red. A simple "line-shifter" is employed for this purpose. A graduated arc indicates the displacement of the line from the zero position, and thus gives the radial velocity of the portion of the flocculus under observation.

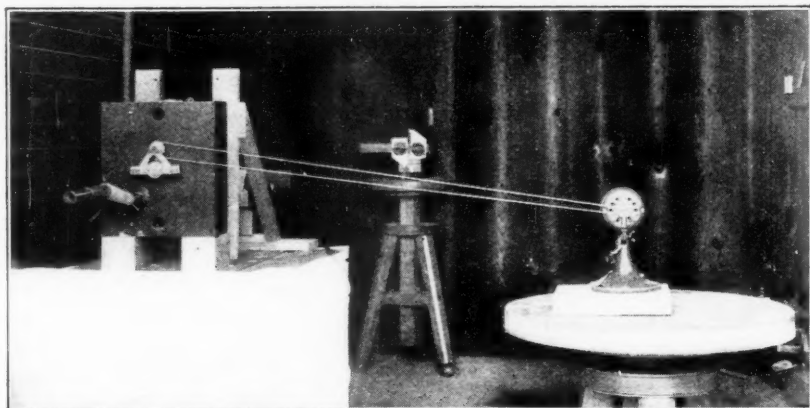
In the above design the slits are only $3\frac{1}{2}$ inches apart. They are therefore mounted horizontally, so as to permit direct observation through the second

slit by the right eye without obstruction of the solar image on the first slit by the observer's head. The bar that carries them, like the slits themselves, is extremely light and stiff. An upward extension of this bar is pierced by a fiber-lined vertical groove, in which a steel pin, fixed eccentrically in the head of a horizontal shaft, serves as the driving device. A small electric motor, belted to a pulley on this shaft, causes the slits to make thirty or forty single oscillations per second. The amplitude is about a quarter of an inch or less, and the motion is smooth and quiet, although there is a slight flicker unless a higher speed is used, which is likely to cause vibration of the grating, unless this is very firmly mounted on an independent support. However, a little flicker does no harm, and is soon forgotten by the observer.

THE second slit is viewed through a positive eyepiece magnifying from two to four diameters. The line-shifter, a strip of plane parallel glass, is mounted behind the second slit on a short shaft, provided with a large milled head for easy rotation by the observer and a divided arc showing the displacement in Angstroms or the equivalent radial velocity. An important adjunct is a screen to prevent the diffuse light of the collimating mirror from reaching the eye of the observer.

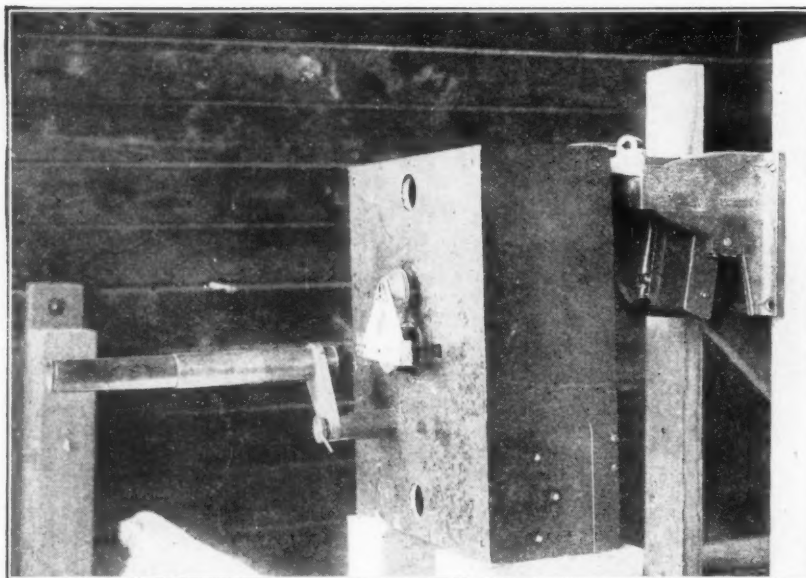
Similar protection against the glare of the bright solar image on the first slit should be provided, and a tube large enough to prevent reflections from its inner walls should extend from the slit to the opening through which the sunlight enters the building. In fact, the observing room should be as dark as possible.

I have found by experiment that with slits 0.004 inch wide, oscillating with an amplitude of $\frac{3}{16}$ inch, the



SIMPLEST FORM OF SPECTROHELIOSCOPE

Sunlight passing through the first slit (right) falls on the collimating mirror, which returns a parallel beam to the grating mounted above the slits, behind the casting. An image of the $H\alpha$ line of hydrogen in the first-order spectrum, is formed by the left concave mirror on the second slit. When the slits are rapidly oscillated by the motor, a portion of the solar atmosphere is seen in hydrogen light through the eyepiece on the left (here turned aside to show the second slit). The entire apparatus may now be had ready made



OSCILLATING SLITS, EYEPIECE, GRATING HOLDER

These parts are shown mounted on temporary wooden supports. The eyepiece is pivoted and may be swung out of the way. The amateur may himself construct much of the apparatus

bright and dark hydrogen flocculi can be well seen on the Sun's disk when the grating aperture is reduced to $1\frac{1}{10}$ by 2 inches. A larger grating naturally gives a brighter image, in which more detail can be seen, but the above will serve for most classes of work.

Suitable gratings, even of the smaller size just mentioned as a minimum, may not be obtainable. I have therefore tried a less expensive arrangement, which may be adopted by amateurs who wish to build their own instrument and are content (until a good grating or reflecting replica can be obtained) to see only the more conspicuous phenomena. This is a pair of 60° prisms, which should be of very dense flint, and may be only just large enough to transmit a beam one inch in diameter, although a somewhat larger aperture is preferable. The dispersion of two ordinary flint prisms (here made equivalent to four by the use of a small plane mirror, which returns the light through the prisms to the second concave mirror) is less in the red than that of the first order of a (15,000) grating, and their performance is much inferior to that of a good grating; but with suitable slit widths they will show the stronger bright and dark flocculi, as well as the prominences at the limb. If, as I greatly hope, a satisfactory method of producing cheap reflecting grating replicas of excellent definition can be found, these may ultimately become available in place of original gratings or prisms.

A BETTER design for oscillating slits has recently been developed by my instrument maker, Mr. Hitchcock. In this form the slits are vertical and farther apart, and the driving mechanism is improved.

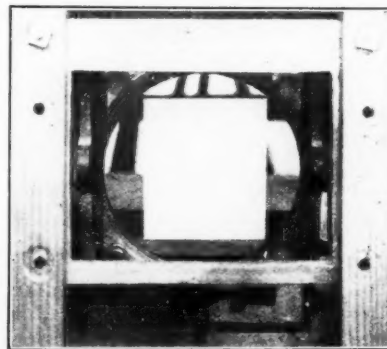
As in the case of the spectroheliograph, a monochromatic image can be produced either by motion of narrow slits with respect to the solar image, or by motion of the solar image with respect to the slits. The chief difference between the two instruments lies in the fact that the spectroheliograph builds up its image gradually, slit-width by slit-width, by a slow motion of the slits or of the solar image with respect to the photographic plate, while the spectrohelioscope must reveal a considerable area of the image at once to the eye, which obviously could not see the forms of the flocculi through slowly moving slits a few thousandths of an inch wide. Hence the rapid motion of the slits or of the solar image required for the spectrohelioscope.

I have tried successfully oscillating bars carrying from one to five slits at each end and a rotating disk carrying fifty radial slits. The most effective means I have tested of producing rapid motion of a portion of the solar image with respect to fixed slits is a square prism of glass mounted before each of the slits, rotating uniformly about an axis parallel to them. The portion of the solar image under observation reaches the first slit through one prism, while the resulting fixed monochromatic image is seen in an eyepiece focused through the other prism on the second slit. This ingenious device is due to Dr. J. A. Anderson. It is somewhat more expensive than the oscillating slits, and seems to show no details of the flocculi not visible with them. However, the elegance of this method, and the complete freedom from vibration and flicker which it affords, make it an attractive alternative for oscillating slits. It can be readily attached to any Littrow spectroscope of suitable

dispersion, but I have found this type of spectroscope (in which a single lens serves for both collimator and telescope) much less satisfactory for the purposes of the spectrohelioscope than the two-mirror form illustrated, because of the impossibility of excluding from the eye the light due to the illumination of the collimating lens and the grating behind it by the sunlight from the first slit. The reflected light can be excluded by using a suitable lens for the collimator, but the remaining diffuse light, superposed upon the $H\alpha$ line, materially reduces the contrast of the flocculi, even when a suitable red glass is placed over the eyepiece.

THE spectrohelioscope shown in the illustrations was built from various parts that happened to be available, and does not represent the final design. The working drawings show a more compact support for the two concave mirrors, and various other improvements. Blueprints of these drawings, detailing all the parts of the various instruments mentioned in this paper, may be obtained at low cost by writing to the Mount Wilson Observatory, Pasadena, California. It should be stated whether blueprints are wanted of (A) the least expensive form of spectrohelioscope (shown in the drawing on page 436); a more expensive form (B), with vertical adjustable slits and improved oscillating bar; or a similar design (C), provided with Anderson's rotating prisms.

In the space here available I have been unable to give many important details regarding the construction, adjustment, and use of the instruments. I hope to describe these partly in the *Publications of the Astronomical Society of the Pacific* and more completely in a small book on solar research for amateurs. Let me add that all those interested should read such books as Lockyer's "Contributions to Solar Physics," Young's "The Sun," and Abbot's "The Sun." I have referred briefly to some of the early work of Lockyer in an article called "Exploring the Solar Atmosphere," published in *Scribner's Magazine* for July, 1928.



GRATING SEEN FROM NORTH

It shows above the windows in the casting corresponding to the two slits

The Three Best Light Planes

Besides a Cash Award, a Gold Medal Will Be Given for the Best Design. Medals Also for Two Next Best

OUR Light Plane Design Competition, the main details of which were given in our April issue and which takes on an added interest because of supplemental awards to be described below, is of particular significance due to the close connection SCIENTIFIC AMERICAN has maintained with aviation since its inception. In the early years, when the science of flight in heavier-than-air



THE CURTISS TROPHY

Won by Glenn H. Curtiss, this was the first given in aviation by any magazine

machines was fighting to gain public confidence, SCIENTIFIC AMERICAN took the lead in sponsoring its progress and, since then, has accorded it much support. Thus, when all the world is looking forward to the early adoption of small light planes for private use, the present competition is especially timely.

Over 20 years ago, on July 4, 1908, Glenn H. Curtiss won the first leg of the first prize ever to be offered by any magazine for a specifically announced flight—the SCIENTIFIC AMERICAN trophy—by a sustained flight in the *June Bug* at Hammondsport, New York. The cup became the property of Mr. Curtiss when he made his famous flight from New York to Albany in 1910.

As the interest in aeronautics shifted from speed to utility several years



OUR GOLD MEDAL FOR THE BEST LIGHT PLANE DESIGN

Through the generosity of Colonel R. Potter Campbell, SCIENTIFIC AMERICAN offers this medal with 500 dollars for the best light plane design; also a silver and a bronze medal

after the war, SCIENTIFIC AMERICAN offered, in 1925, a cup for the best utility plane. This was won by a Powell airplane, a tiny machine equipped with a two-cylinder air-cooled engine of 16.7 horsepower. Piloted by "Jerry" Dack in the 1925 National Air Races, it averaged a speed of 76.41 miles an hour.

For the best design of a light sport plane, SCIENTIFIC AMERICAN next offered a bronze plaque trophy. This was won at the National Air Races of

Thus it was but another step in the sequence to offer an award for a two-seater airplane design to be built around the Cirrus Mark III engine.

We are happy to announce that, in addition to the 500 dollar cash award already detailed in full, Colonel R. Potter Campbell also offers an attractive gold medal for the winner, as well as a silver and a bronze medal for the second and third best designs, respectively.

The committee has added to its numbers, as was originally intended, two men well-known to aviation enthusiasts. The membership to date is as follows: Miss Amelia Earhart, Professor Alexander Klemm, Mr. George Palmer Putnam, and the two new members: Colonel V. E. Clark of Buffalo, New York, and Mr. Reed G. Landis, president of Reed G. Landis Company, Chicago.

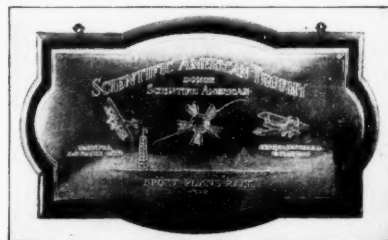
All who desire to enter this competition, which closes August 15, 1929, should write for an entry blank to: Committee, Light Plane Design Competition, care of SCIENTIFIC AMERICAN, 24 West 40th Street, New York, N. Y.



UTILITY PLANE CUP

This cup, given by us in 1925, was won by a Powell plane with a low power engine

1926 by a plane designed by F. E. Seiler of the Kreider-Reisner Aircraft Company, Hagerstown, Maryland. Weight of this plane, fully loaded, was 490 pounds. Piloted by A. H. Kreider, it averaged 94.5 miles an hour and made 99.4 miles an hour on one lap.



SPORT PLANE PLAQUE

A tiny plane weighing 490 pounds, fully loaded, won this award at the 1926 races

Mechanical Etching in Wood

Decorative Woodwork Etched with Modern Mechanical Equipment Rivals the Hand-Carved Creations of Old World Artisans

By LAWRENCE WM. PEDROSE

WOOD CARVING is one of the oldest arts known to man, and by it archeologists are often able to determine the degree of culture and the plane of civilization of the world's primitive peoples. The ancient Egyptians made extensive use of wood for interior decoration, carving and painting it with pictures to commemorate important events. The Romans are believed to have created the wood panel, probably to relieve the sternness of marble and stone in ornamenting their dwellings.

Following the decline of the Roman empire, wood carving languished, to be revived in Italy during the Renaissance. England's early day baronial halls revealed examples of carved wood paneling rivaling those of Italy, and colonial America received much of its inspiration from England.

The wood panel gradually lost in popularity upon the advent of wall paper, which in its infancy copied the designs and tones of the wainscot and panel. Paper was cheap and it brought to the modest home the artistry previously available only to the wealthy. Later, wall paper developed into a medium for bringing bright colors into the home and the wainscot and panel ideas were lost.

Recently, however, methods have been discovered for producing carved wood panels mechanically, and the dignity expressed by woodwork in the early English country houses, and the paneled charm of venerable Italian villas, can now be reproduced at comparatively small expense.

BRINGING decorative woodwork within reach of the average purse has been accomplished through adaptation of old processes and application of the science of a mechanical era. Perhaps the most outstanding of these processes is the sand blast and stencil method, which has long been used in the manufacture of glass. While cutting a design in a glass window, an artisan accidentally turned the sand blast upon an exposed side of a soft board. The sand ate away the softer grain and left the hard grain standing out in relief. This chance discovery was methodically developed into a well defined practice. Before long it was realized that decorative effects similar to those obtained in rare hand-carved panels could be produced mechanically by etching with sand,

and laborious and expensive carving with knives could be done away with.

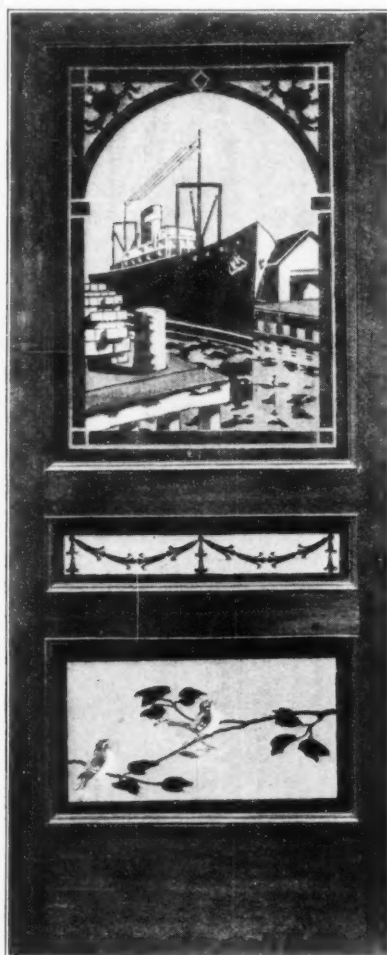
The woods principally used in the mechanical etching process are fir, spruce, hemlock, cedar, and redwood, but any soft wood that has a distinctive grain may be utilized. A fiber or metal stencil is made of the design and placed on the wooden panel. Sand is

pervious to wear. The board may be either of vertical or flat grain, and each produces a novel effect.

Any design or picture that can be stenciled with paint can be reproduced by the sand etching process. Fine lines, intricate patterns, or boldly outlined masses are produced equally well by the cutting action of the flying sand. After the etching is completed, stains may be used to bring out the high lights or accentuate any part of the design. In a variation from the sand-blast method, revolving steel brushes may be used to gouge out the soft wood, but while this process is cleaner in that shavings and not dust result, the sand blast is simpler and permits wider application.

SAND etching is by no means difficult and lends itself easily to amateur experimentation. Stencils are made the same as for painting. The sand blasting can be done at a commercial glass or metal works where equipment of this type is regularly used. Although the commonly known fir, spruce, hemlock, and soft cedars are best adapted for sand-blasting decorative designs, it has been found that almost any soft wood that has a distinctive grain will yield very satisfactory results if reasonable care is taken in etching. Douglas fir plywood can be obtained at any large retail lumber plant. The number of designs that can be worked out are almost limitless and depend only on the ingenuity and artistic ideas of the experimenter. If colors are desired to produce effects other than those of the natural woods, ordinary inexpensive stains are used with unique and interesting results.

A notable example of mechanical etching is to be seen at the nation's capitol, in the so-called "Wooden Room" of the Pan-American building at Washington, D. C. This room was finished in Douglas fir, a commonly known wood, and unusual designs were worked out to emphasize the quality and attractiveness of native American woods for interior decoration. Recently a large, modern hotel was constructed on the Pacific Coast with all interiors in decorative wood paneling etched by the new process. The luxurious finish of the woodwork in the salons and cabins of the new French steamship *Ile de France* furnish another up-to-date version of Old World artistry expressed in wood.



DECORATIVE PANELS

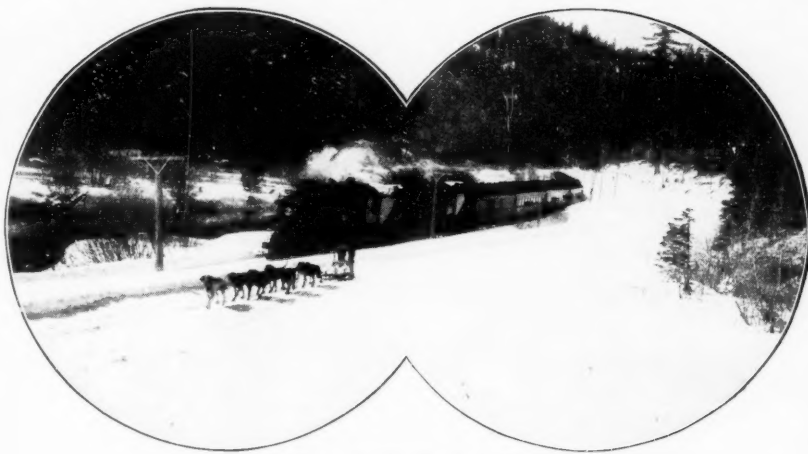
Sand-blast etchings in plywood door panels with effects accentuated in colors

then applied under pressure and the soft wood between the harder grains is eaten away, producing a relief effect that is very pleasing to the eye. The annual rings in the tree from which the lumber has been cut provide the essential grain. The wood marking the tree's spring growth is soft, while that grown in the summer is almost im-



FRED PRINTZ—WINNER

Printz' time for the three laps totaling 96 miles was 8 hours, 39 minutes, 17 seconds



COURSE PARALLELED RAILROAD

The Sierra Dog Classic was run off on a course that was located parallel to the tracks of the Southern Pacific Railroad. Special observation trains were run for spectators and camera men

Dog Teams Race in California

CALIFORNIA, land of sunshine and orange blossoms, has taken unto itself a new sport. And this sport is nothing more or less incongruous with the average person's idea of California than racing with sleds and dog teams after the manner of the far north. A Sierra Dog Derby was recently run under the auspices of the Sierra Dog Derby Association, which is sponsoring winter sports in northern California and Nevada.

Staged only a few hours ride from the orange groves and the almond blossoms of the Pacific Slope, this innovation is bringing sled teams to the Lake Tahoe regions from all parts of the country. The races are not of the endurance type familiar to the more northern regions of this continent, but are of sufficient length to enable the teams and drivers to demonstrate their stamina, speed, and generalship, and to make possible split-second finishes that are thrilling alike to spectators and contestants. They are run in three laps over a course of 32 miles, extending from Truckee, on the old Overland Trail to Tahoe, on Lake Tahoe, and paralleling the tracks of the Southern Pacific railroad.



MRS. GEELAN

This 24-year-old bride battled bravely, but finished in fifth place



SCOTTY—AND SCOTTY

On the right, Scotty Allen, winner of second place. On the left, Scotty Malemute, Allen's lead dog

In the Derby run during last February, the total 96 miles were covered in 8 hours, 39 minutes, 17 seconds by Fred Printz, who won first place. Second came Scotty Allen, with his famous team of malemutes, who covered the course in 9 hours, 9 minutes, 18 seconds, just nosing out Roy Stover, who finished in 9 hours, 10 minutes, 42 seconds. Earl Kimball came in fourth in 9 hours, 13 minutes, 19 seconds, driving a team of red Irish setters. Mrs. Thula Geelan finished in fifth

place, in 9 hours, 33 minutes, 19 seconds.

The Southern Pacific ran special observation trains over their tracks on the three days of the races to accommodate spectators and camera men. Excellent foresight on the part of those responsible for arrangements made possible easy handling of the crowds, and provided adequate arrangements for feeding them. California has undoubtedly established itself as a state for winter sports, as well as for continuous sunshine.



All photographs courtesy Southern Pacific Railroad

DOWN THE STRETCH

Fred Printz driving his team of Gordon and Irish setters along a smooth part of the course. Spectators gathered along the route



AT THE TAPE

Roy Stover, who finished in third place, drove a team of seven Llweelyn setters. The dog team is shown here ready to start



THE LONG GRIND

Grinding and polishing required over 1000 hours of work with eight-inch tool

IN the January, 1928, issue of the SCIENTIFIC AMERICAN mention was made that I was grinding a 21-inch disk for a Newtonian reflectory telescope to be used in Jamaica. This disk has at last been completed after 18 months of labor, and is mounted as a split-ring equatorial similar to the "Garden" telescopes designed by Russell W. Porter and suggested by Professor Pease for the mounting of a 25-foot reflector (SCIENTIFIC AMERICAN, September, 1926).

The split-ring and back bearing were connected by large, strong pipes with bolts running through them. This made of the assembly one complete piece, and the whole polar axis splitting and back bearing was turned up as a single piece on the lathe. The vertex of the cone has an angle of 36 degrees, so the lower side of the cone when set up is parallel with the surface of the ground at this latitude, 18° N.

THE declination axis is supported by roller bearings and thrust ball-bearings in a single shell. The back bearing is also made up of a similar set of roller and thrust bearings. The two large bearings below the splitting are ball bearings.

The complete instrument weighs approximately 1600 pounds; the largest solid iron weight over 600 pounds. The mounting was made to my design by the Kingston Industrial Works here in Jamaica.

To describe the performance of such a mounting it is best to show its defects from the first, be they inherent or due to faulty design. If I were to make another mounting, no matter what size, the ring itself would probably be

made proportionately larger. This would allow the counterweights to be placed farther from the declination axis, and therefore they could be less cumbersome and of less weight. It would also allow the tube to be balanced easily, no matter what instruments were placed on the eye end. On the other hand, if the split-ring were made larger, the declination axis would be proportionately longer, introducing liability of flexure. The weights, being farther from the axis, might also flex. In the present mounting the whole telescope tube with the declination axis and weights is to all intents one solid block.

FLEXURE from the bending of the tube is reduced to a minimum, since the mirror rests upon the declination axis, and the tube bears only the negligible weight of the instruments at the eye end.

All heavy weights are close to the axis, therefore there is no vibration as the telescope moves. Inertia, which is easily overcome when necessary, keeps the telescope rigidly on the object observed without the trouble of clamping. When clamped rigidly, any vibration that may occur in the mounting becomes doubly evident, so I prefer what might be called a "finger adjustment" to all moving parts. This mounting can literally be moved with the little finger and the object will remain steady in the field of view.

If I had listened to all that has been said about the difficulty of constructing a mirror over eight inches in diameter, this 21-inch mirror would hardly have been commenced. It was found at the start, when the rough casting as it came from the Saint-Gobain works in France was unpacked, that a 160-pound disk is no small block to handle with means such as are found in a country house at least 60 miles from the nearest machine shop.

The first requirement was a stand on

which to place the mirror for work, and since I could not lift the glass for testing after every polish, the tray in which it rested had to be made to tilt almost vertically. Ford parts came to the rescue, a Ford rear axle serving as a pivot on which to turn the tray and mirror.

The most difficult part of the grinding was bringing the back of the mirror approximately even and parallel to the front. For this was used an eight-inch tool one inch thick. This, by the time the work was finished, was reduced to one eighth its original thickness.

For the face, a 12-inch tool that had served as the tool for my previous mirror was used. Both the rough and fine grinding were quite easy with a straight, over-center stroke. At first the tool was convex and this at once started a concavity in the big disk and prevented the turned edge which would have been likely to occur if I

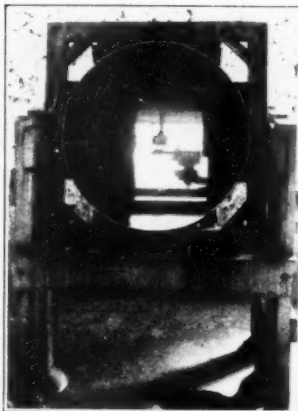
had used a full sized tool—the mirror, of course, being underneath and face up.

I made sure of the curvature at first by alternately grinding a new 12-inch disk and testing this 12-inch at its center of curvature by the ordinary wet surface method. As long as the tool remained in contact with both disks after a few strokes on each it was evident that the large disk was within bounds.

This alternation was kept up through the first three grades of carborundum; so I now have a second 12-inch

mirror very nearly in a condition for polishing.

THE pitch lap was made in the usual manner, except that the pitch was boiled to make it harder in this climate. Grooves were cut in it initially, but these soon filled up. It was then used as a plain surfaced lap right through the polishing of the mirror up to the final strokes, without change, the tiny, evenly spaced pits in it caused by the bubbles due to



TIPPED UP FOR TESTING

The slide rest of a lathe was used to hold lamp and knife-edge. Its reflection is visible

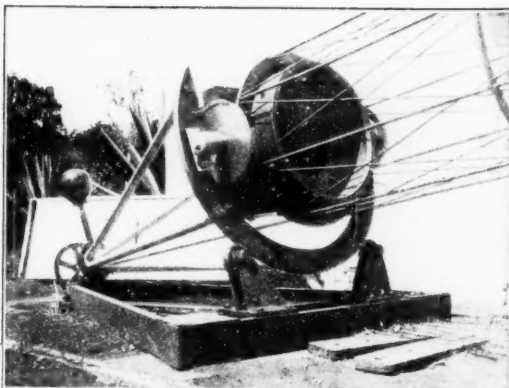
boiling the pitch acting very much like the depressions in the honey-comb foundation lap.

In using the 12-inch tool on the 21-inch disk, a straight over-center stroke caused a zone to form in the mirror six inches from the center. This was evidently the envelope of the trails formed by the edge of the tool as it traversed the disk. A chord stroke with center of tool half way between the center and edge of the mirror also made a shallow zone—in fact, anywhere off center the center of the tool seemed to grip more than the rest. The best stroke was an elliptical one of great eccentricity, nearly a straight stroke, in fact, but with the center of the tool about one and one half inches off center, and never lapping the edge of the tool over the edge of the mirror by more than the same amount. This stroke smoothed and corrected the whole surface of the mirror.

VERY little has been written on the correct amount of grip the tool should have on the mirror while polishing. When used in a thick paste, the rouge seemed to scratch, but when watered, the tool floated over the surface of the mirror with a consequent waste of rouge and no results. The mirror was finally covered with a medium mixture of rouge smoothed over the surface by a few strokes of the tool. This mixture would stiffen up slightly while cold pressing. The tool would then grip fairly well—the rouge under these circumstances turning from red to orange by an admixture of pitch or turpentine out of the lap. A book might be written on this subject alone.

In parabolizing, I used cardboard disks with one or two complete half-inch zones cut out. There were 15 of these in all. Since, owing to diffraction from the edges of the zones, the eyepieces can not focus well enough the images of the pinhole formed by

these zones, I used the knife-edge to test the intensity and equality of the light, as explained in "Amateur Telescope Making" and in Ritchey's writings, comparing the dark streaks in the center of each zone at right and left. When bringing up the knife-edge, the bottom and top portions of the zones would naturally darken from the knife-edge outward if inside



DETAIL OF MOUNTING

Bolts in the forward portion of the bottom frame and in its tail adjust the telescope with precision, for azimuth and altitude

more accurate than comparing the left and right sectors for equal light intensity.

My final plotted curve for $r^2/2R$, the modified formula used when the lamp moves with the knife-edge, showed that the greatest error, outside the central part which would be cut off by the flat, was no more than 0.008 of an inch. The focal length is 128 inches.



THE EYEPIECE END

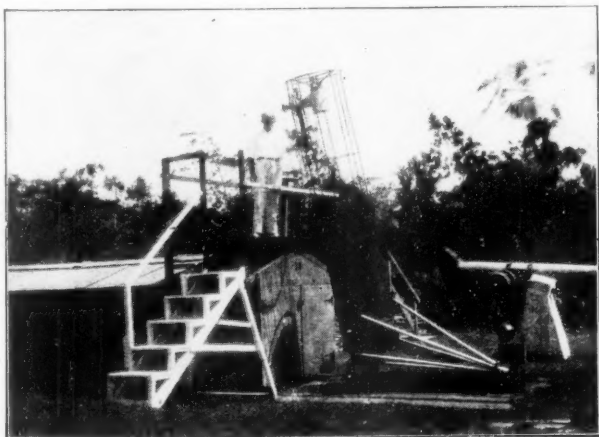
A temporary cardboard dew cap protects the diagonal flat, and seems to work perfectly. Note prism on the finder

focus, and inwards toward the knife-edge if outside focus. One then had only to run the knife-edge quickly in and out to see a shadow pass backward and forward along the top and bottom of the zone. The quicker one did this the more marked it was; the only place where there was no such motion, but a uniform darkening, being at the focus. I found this even

THE silvering was by the Brashear process and was a success the first time. For practice I first gave my 12-inch its second coat.

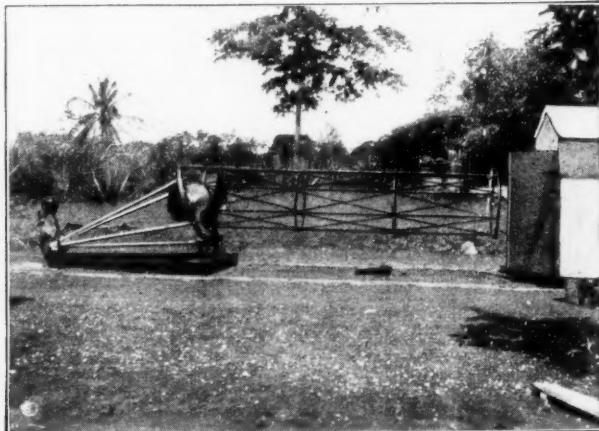
The whole mounting and mirror complete must have cost between 800 and 1000 dollars, not including my own labor and time. I was grinding and polishing for 18 solid months, with about half hour intervals for polishing and a test following each. I averaged at least three polishes a day. However, one would be able to do the job again in a much shorter time.

After initial experience gained on smaller mirrors, some amateur telescope makers are attempting larger sizes. One amateur tells, on page 464, how he made a 16-inch telescope.



THE SHED AND OBSERVING STAND

The shed carries the observing stand on its top. A smaller telescope, described in the issue of January, 1928, also shows



HOW THE SHED IS USED

It is mounted on rollers and is rolled bodily over the entire telescope, after the tube has been lowered to a horizontal position



THE BEGINNING

The collected trash is loaded in trucks, in which are unloading nets. To unload, a cable pulls net and trash from the truck



THE INITIAL SORTING

Expert pickers are stationed along an endless conveyor which carries the trash. They remove all articles likely to be saleable

Rag-Picking as Big Business

In Washington, D. C., Household Refuse Is Collected by the Municipal Government and Much of it Is Reclaimed

By G. H. DACY

A STERLING example of the practice of business thrift and husbandry shines brightly in Washington, D. C., where the authorities supervise the work of reclaiming all but the soot from the 225,000 cubic yards of trash and refuse which the street cleaning department collects annually.

Baltimore and Pittsburgh, also, follow the Washington plan of "saving all of the hog except the squeal." These three cities devote several million dollars of municipal funds yearly to the collection of trash and refuse from the private homes of all householders within their corporation limits. Instead of hauling this million tons or more of rubbish to public dumping grounds and burning it, this trio of provident cities delivers the material at special reclamation plants. There all saleable stuff is segregated and sold, and the remainder destroyed in special incinerators.

Our national capital, a city of 100,000 homes and 500,000 residents, salvages more than 100,000 dollars in paper, tin cans, bottles, broken glass, and rags from the trash which it collects every twelve months. There is an appropriation for the daily removal of trash, refuse, ashes, garbage, and dead animals. Seventy five thousand tons of garbage are reduced to grease at a special plant owned by the District of Columbia and subsequently sold for 250,000 dollars. Collected trash is sal-

vaged in a similarly profitable manner.

A huge electric press is employed to compress into bales millions of tin cans, which range in size from a face powder box to a large garbage can weighing 85 pounds. Eighty thousand of these bales are shipped each year to a Baltimore mill, where the tin is melted and made into window sash weights. Washington sells its trash tin for six dollars a ton. The annual return from this refuse rescued from ruin amounts to approximately 20,500 dollars.

BOTTLES of all shapes, sizes, and patterns are sorted from the trash by the hundred thousand and are sold to junk dealers who, in turn, return the glass containers to the beverage manufacturers and other establishments which use them. All the milk bottles are salvaged and returned to the central milk bottle exchange in the Capital City. The city of Washington sells its salvaged bottles for from 75 cents to four dollars and a half a gross. Broken glass, which is also reclaimed by the freight car load, brings six dollars a ton when eventually consigned to glass factories which use it as raw material in manufacturing glassware, window glass, containers, and like supplies.

One carload of paper, equivalent to 30 tons, is reclaimed daily from the refuse. The salvage value of this paper aggregates about eight dollars

a ton. The paper is compacted into large bales weighing from 900 to 1200 pounds and is sold to paper mills throughout the United States. These mills soak and macerate the paper and reduce it to pulp. The final merchantable product made from it is compressed cardboard. Washington gets 80,000 dollars for baled waste paper annually.

The rags are graded into ten different classes and are sold to junkmen, who finally deliver them at special contract prices to paper mills. The old sheets or window curtains which a Washington lady throws away this month, she may buy back in the form of fancy writing paper or wrapping paper several months later.

Mechanical appliances aid in the reclamation of the marketable materials from refuse. The trash is hauled by a large fleet of motor trucks and horse-drawn wagons from all parts of the District of Columbia to the trash plant. Each vehicle is equipped with a metal net like an old fashioned hay sling. This steel sieve is placed in the bed of each vehicle, with an extension reaching to the top of the load. When the truck arrives at the unloading platform, a steel cable operated by an electric motor links to the exposed end of the unloading net. In the twinkling of an eye, the load of trash is deposited on the platform.

Electric power operates also a paper plow to push the trash to an endless

belt conveyor of steel. This corrugated belt is 300 feet long and three feet wide. It elevates the trash to the second floor of the salvage factory. Then it carries it, stream flow fashion, before 24 adept pickers and graders who sort the miscellany of rubbish as it flows methodically in front of them. Each picker is a specialist. One snatches bottles and tosses them into a special bin. Another picks rags. A third removes paper from the conveyor and throws it into gravity chutes which deliver it to the paper balers. Other workers handle tin cans, books, or magazines.

The trash which remains on the endless steel belt when it reaches the far terminal of its course is dumped on another conveyor which operates at right angles to the direction of the original belt of steel. Several pickers face this smaller conveyor and remove any saleable trash which by chance has escaped the first crew.

THIS conveyor dumps its remnant cargo into a mighty incinerator 12 by 50 by 75 feet in size. This refuse consists of soiled paper, wall paper, paint cans, wooden baskets, crates and bales, old parasols, worthless rags, and other debris. Four firemen operate the huge furnace which has a stack 65 feet high and 12 feet in diameter at the base. Smoke and fine ashes are the only residues of this incineration.

You can appreciate that the salvage is most painstaking when you learn that only two tons of trash are burned daily. Some 780 cubic yards of trash are delivered daily to the salvage station and all except this two tons are returned to the channels of commerce as merchantable articles. Here is a lesson in thrift and economical management which many other American cities might practice profitably. The ma-



SORTING THE BOTTLES

Reclaimed bottles are carried on a rubber belt to a sorting room where they are graded and packed, ready for sale. They are used again as containers.

jority of municipalities do not collect and destroy trash. They require individual home-owners to handle such activities. Washington, Baltimore, and Pittsburgh have blazed the trail and demonstrated not only that municipalities can perform such work, but that they can do it at a profit.

The bottles at the Washington establishment are transported on an endless conveyor from the main building to the subsidiary glass salvage plant. As the flow of bottles passes the expert pickers, they remove the different sizes, shapes, and varieties. The bottles are then packed in crates and barrels and delivered to professional junk dealers.

THE broken glass is loaded directly into gondolas of 300 barrels capacity. The city trash plant furnishes irrefutable evidence of whether or not prohibition is enforced. Washington tosses almost as many spirituous liquor bottles into its ash cans as it did before the demise of John Barleycorn, according to trash plant records.

The best trash harvest of the year comes about Christmas time. The

wrapping paper from countless Yuletide gifts is ultimately delivered to the reclamation establishment. This fresh, clean paper is simple to salvage and easy to sell. In Washington, the daily paper salvage increases to approximately 100 bales for several weeks after Santa Claus's annual visit. This is about double the ordinary paper recovery.

THE scent of romance and the spice of adventure find their devious ways even to such an extraordinary meeting place as the municipal refuse station. Newlyweds seeking lost rings come as a last resort to this rescue establishment. Senators' wives and congressmen's daughters who carelessly toss their jewelry bags into the discard drive in costly limousines to this fount of rejuvenation. One matron hurried there recently in search of her lost cat.

A prominent member of Washington society last winter rolled 25,000 dollars worth of diamonds in a chamois bag and carelessly left the bag on a table where her little son found it and carried it to the trash can. When the lady missed her costly gems, the police were called in, the house was searched and finally the lad confessed that he had played with the little bag of "pretties." An organized search was carried on at the trash plant for more than a week—but without success. The trouble is that the trash pickers learn of such losses too late. The trash is sorted and the residue destroyed as soon as delivered at the establishment. Usually the news of the loss of jewelry, money, and other valuables does not reach the refuse station until the rubbish which might have contained such precious articles has passed through the plant and is already consumed in the incinerator.



FUTURE SASH WEIGHTS

Millions of tin cans are collected and placed in a press where they are baled. These bundles are sold to a sash-weight manufacturer.



THE END

After passing before many trained sorters, the remaining junk is scrutinized again and then shot down to the huge incinerator.

Inventions New and Interesting



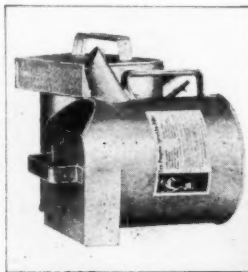
NOVEL RUG FOR PLAYING GAMES

This new game rug is woven of finest materials in several sizes, qualities, and shapes. The design is woven into the rug, and provides a number of fascinating games, based on such familiar old favorites as quoits, pitch, poker, and indoor golf, either by pitching or putting.—*Sealan's, 347 Fifth Avenue, New York, N. Y.*



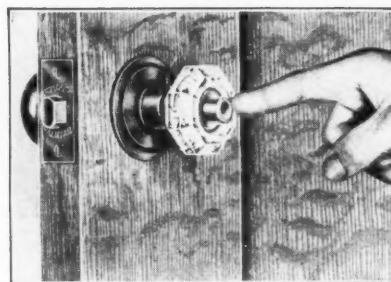
ELECTRIC HEDGE TRIMMER

One of these high speed electric trimming devices will enable anybody to trim a hedge neatly, quickly, and without hard work. The blade rotates at about 5000 revolutions per minute, and can be resharpened easily. The tool weighs less than six pounds, and has a switch on the handle. It is provided with 100 feet of wire.—*American Implement Co., Newark, New Jersey*



COMBINATION SPRINKLER, SPRAY, AND FILLER

With this device, one can give the car or the baby a shower bath, sprinkle the flowers, spray the potato bugs, fill the radiator of one's automobile, and water the lawn or garden. The utensil has two handles, one at the side and one on top. It has a capacity of eight quarts.—*Closed Top Utensils Co., 316 S. Clark St., Chicago, Illinois*



DOORKNOB LOCK

This doorknob provides a convenient lock, which operates when the button is pressed. It opens from the inside by simply turning the knob, but a key is needed to enter.—*Schlage Lock Company, San Francisco, California*



METAL CLOTHES PIN

These metal clothes pins are said to have more spring than the familiar wooden ones. They are designed to grip a line of almost any size, and are nearly indestructible.—*Milbest Manufacturing Co., 530 Wisconsin Avenue, Milwaukee, Wisconsin*



PORTABLE CABIN FOR CAMPERS

Those who want the utmost in comfort, coupled with ease of transportation in their camping equipment, will find this easily assembled house a pleasant place to spend a night, a week, or a month when in the great out-of-doors.



No nails or bolts are required; the room space is about 9 by 12 feet, and the windows are made of non-breakable material. The roof is made of double canvas.—*Fold-A-Home Manufacturing Co., 239 7th St., San Francisco*



PORTABLE NINE HOLE GOLF COURSE

All one needs to convert a carpet or closely-cropped lawn into a "nine hole golf course" is a set of the runways and "holes" illustrated above. Each hole is different, and can be placed in any desired spot. As the game is played entirely with a putter, the ball is not lifted from the floor, and consequently it is safe to play the game indoors.—*Viophonic Corporation, 285 Madison Avenue, New York, N. Y.*

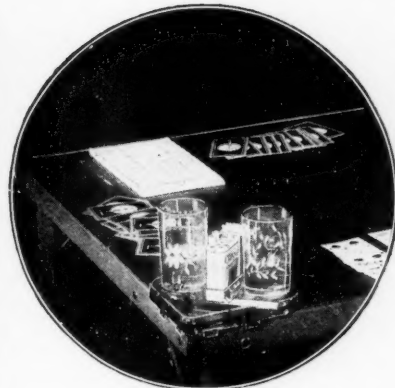


← DUCK HUNTER'S KNAPSACK

Designed primarily for duck hunters, this knapsack holds six boxes of shotgun shells in a separate compartment. The usual space is provided for food, clothing, utensils, and a thermos bottle. An overlapping top cover affords protection against weather, and leather shoulder straps with snaps add to its appeal to hunters.—*E. C. Montagne, 269 Pine Street, San Francisco, California*

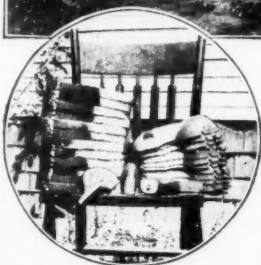
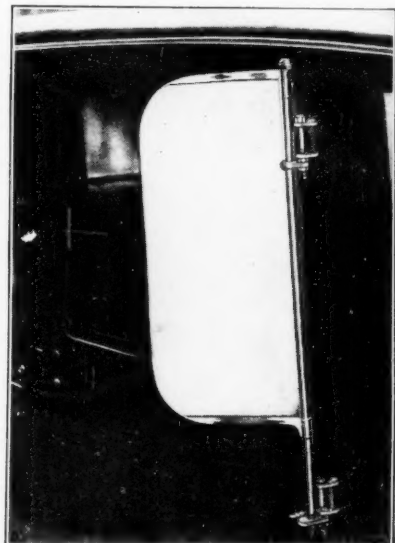
CLOSED CAR WINGS ➤

To overcome back drafts and make driving in a closed car more of a pleasure, wings have been provided that can be attached to the door hinges without marring the car. The wings turn with the door. They are intended to permit riding with windows open, to provide a maximum amount of fresh air without danger from drafts.—*Tonneau Shield Company, Inc., 518 57th St., New York*



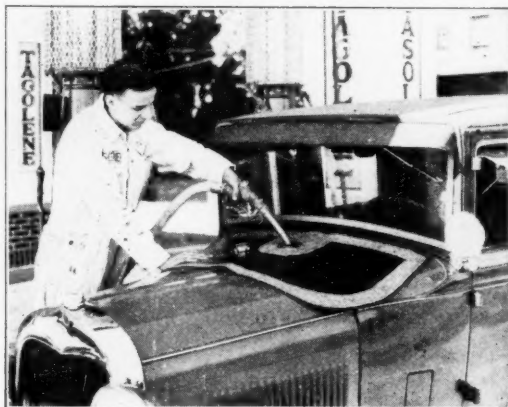
REFRESHMENT TRAY

Easily washed glass trays now bid for a place on the card table. They are made in amber, green, or rose, and have places for two glasses, cigars or cigarettes, matches, and ashes.—*Louis Levin Sales Company, 24 West 23rd Street, New York, N. Y.*



IMPROVED DUCK DECOYS

These portable decoys can be assembled or taken apart quickly, and are said to be unusually lifelike on account of an improved flat bottom that enables them to "ride" the water like a live, wild duck. The bottom, body, and head are manufactured separately. The head can be adjusted easily.—*Ideal Decoy Manufacturing Company, Klamath Falls, Oregon*



COWL MAT PROTECTS FINISH

To protect the finish on cars having the gasoline tank located beneath the cowl, this rubber coated cloth mat has come into use at several service stations. The mat absorbs drippings and guards against scratches from the hose.—*Hinson Manufacturing Company, Waterloo, Iowa*

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Extra Wheels on Buses for Greater Safety

PASSENGERS in motorcoaches are often concerned with the question of what might happen should a tire go flat while the bus is traveling at a high rate of speed. It is a well known fact that under such conditions the driver may lose control and the vehicle crash into obstructions, resulting in injury or death to passengers.

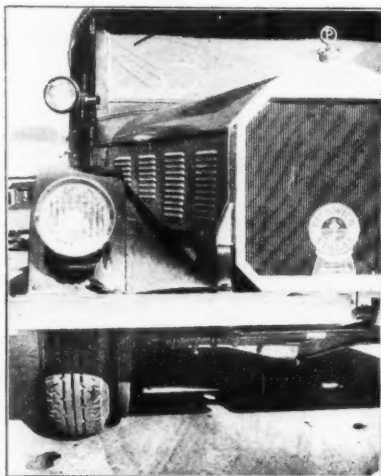
A western stage system has adopted a special wheel which has an inner rim holding a solid rubber tire of a diameter slightly less than that of the pneumatic tire. If the service tire should go flat, the car will drop just enough for the solid tire to touch the road and will continue on this latter tire. Thus the driver retains control of his car and can drive slowly to the nearest service station, if necessary, for repairs. Besides the safety feature, the extra wheel has the added advantage of protecting the pneumatic tire from rim-cutting when deflated.

Two World's Largest Generators

THE Hell Gate Generating Station of the United Electric Light and Power Company, on completion of the installation of two 160,000 kilowatt (215,000 horsepower) turbo-generators, will become the largest steam generating station in the world, having a total generating capacity of 605,000 kilowatts (811,000 horsepower.)

The installation of these two huge machines with their equipment of condensers, piping, cables, and switches, represents an investment of 6,000,000 dollars. One of these machines is now ready for commercial operation and the other will be ready in a few weeks. They give a striking illustration of the progress made in electrical engineering art. By increases made in the efficiency of the steam-producing and electrical parts of the machines, great increases in the total capacity have been made without corresponding increases in the bulk of machines. One of these 160,000 kilowatt machines, built by the American Brown Boveri Electric Cor-

poration, will occupy a space in the station originally reserved, in 1921, for a machine of only 35,000 kilowatts and is being installed beside the second which is of Westinghouse Electric and Manufacturing Company construction. Each of these machines will be more than three times the capacity of any one of the largest machines now operating in the station. These other machines are two units of 50,000 kilowatts



Bus wheel showing the extra solid tire wheel which comes into use if tire on the main wheel is punctured

capacity, two of 40,000 kilowatts, and three of 35,000 kilowatts.

One of these new machines operating continuously could have supplied all the power consumed in the entire country for lighting purposes in 1906. It can light 3,200,000 50-watt lamps. Each machine could lift the giant *Leviathan* steamship, of 59,000 tons displacement, into the air at the rate of one foot per second.

Both machines are designed to operate with steam at 265 pounds pressure at the turbine throttle, 725 degrees total tem-

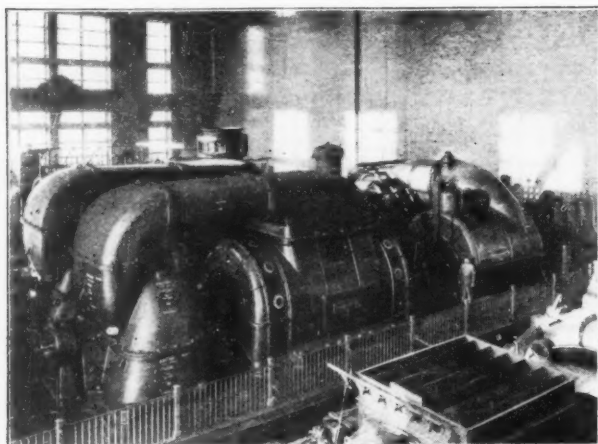
perature. The Westinghouse machine is somewhat lighter than that of the American Brown Boveri Company, the former weighing 673 tons as compared with 730 tons for the latter. The 160,000 kilowatt capacity of these machines is around 50 percent higher than that of the previous world's largest.

Pitchforks Grow on Trees in China

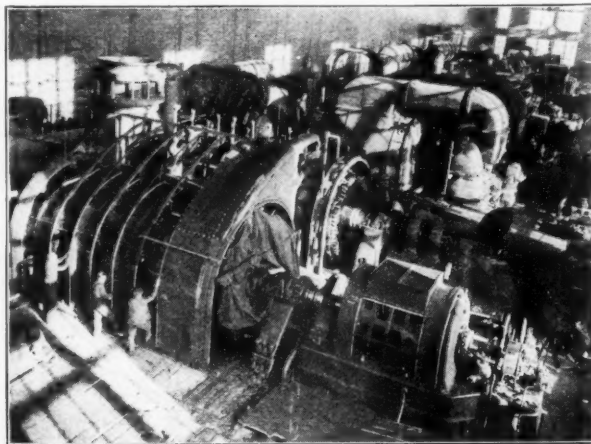
EXPLORING in China in hopes of finding superior varieties of plants for introduction into the United States, a representative of the United States Department of Agriculture encountered a peculiar method of "growing agricultural implements." The explorer, P. H. Dorsett, observed, near a village about 50 miles southwest of Peking, long hedgerows of willows, but gave them no particular thought, as willows are grown commonly for hedges and for firewood.

He learned, however, that these plants were selected for a special purpose. Grown as bushes, one or more shoots from each crown are allowed to grow 6 or 8 feet from the ground. These commonly produce branches at that height at points nearly opposite on the main shoot. The main shoot grows up in the center, making what is roughly a three-tined fork or trident. The lateral branches and the center shoot are finally cut back to within two or three feet of the point where the branches originate.

"The making of these branched sticks into harvest forks," says Mr. Dorsett, "is a more or less simple operation. The bark is stripped from the stem and branches. A dozen or more are placed at a time in an open-top brick-lined oven or kiln to be heated. The green wood, which is sprinkled with water from time to time, is soon steaming in the heat from the fire below. After the forks have been steamed in this way for an hour or two, the branches can be bent without danger of breaking. The forks are placed in a rough forming frame, and the branches are spaced to form the



The American Brown Boveri 160,000 kilowatt generator which has just been installed in the Hell Gate Station in New York. It is in front of the second generator



The Westinghouse Electric and Manufacturing Company's generator, 160,000 kilowatts capacity but lighter than the one shown at left having the same capacity

tines and give them the proper curve. The tines are held in place by pegs. They remain in the frame about six weeks, dry, and are stored. When they are wanted for the market, the tines are pointed and the handles smoothed for use. The finished article sells for about seven cents in American money."

Evolution of Logging Cart Bearings

EVERY so often an example of inorganic evolution appears that is interesting for the light it throws on the changing phases of human activities. This particular case has to do with the picturesque process of logging, and describes as well or better than any amount of words, the steady progress of the mechanization of lumbering processes.

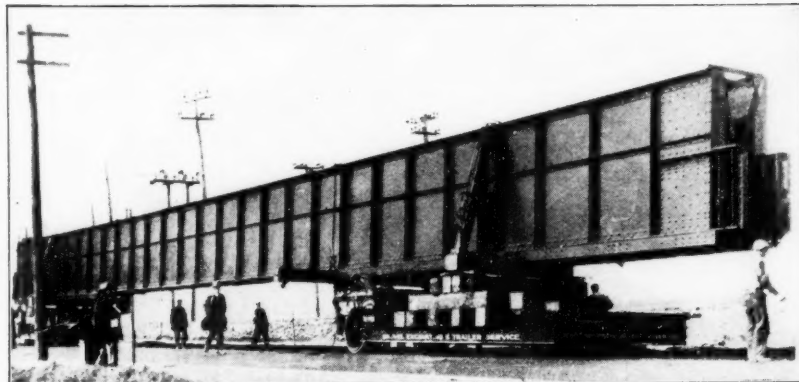
In the early days of lumbering, which are not so very long ago at that, horses



Old style wooden hub and wooden axle used years ago on logging carts

did most of the heavy hauling, so speeds were low, and loads were light. For such conditions, a wooden hub and wooden stub axle on the log cart apparently gave perfect satisfaction. The bearing, if it could be called such, consisted of a rough cast-iron cylinder, slipped into the hub, which bore on two strips of one quarter by one half inch steel inlaid in the upper and lower surfaces of the wooden axle.

This cart served its purpose until the introduction of tractor logging. The increased power available made heavier loads on the carts possible, and increased the rate of speed. Thus it was necessary to strengthen the construction all around. The next step consisted of making the hubs of cast iron, with the bore machined. The axles were made of steel and machined to fit the hubs. Finally, the hubs entered the last stage of their evolution—the application of anti-friction bearings. The method of mounting the tapered roller bearings that were adopted in this particu-



One of the massive girders that were moved from the freight yards to the point of erection on huge rubber-tired trailers, as described directly below

lar case is fairly obvious from the illustration.

The previous type of hub had to be drenched in lubricant every so often if it was to keep operating properly. This meant not only that lubrication expense was high, but that a lot of it went for wastage. And, while the money spent for lubricating carts was a minor item in the general expense of operations, its reduction was desirable. Secondly, the plain bearing wore with use; swaying loads and rough ground shortened its life. Wheels became wobbly, and the cart had to be taken out for repairs before matters got to the point where some real damage might be done. With the present form of bearing mounting, these expense leaks are stopped. The cost of lubricant, and the frequency with which it must be applied are both reduced, and wastage is eliminated. Maintenance necessitated by bearing trouble has practically ceased to be a factor in operation. Briefly, the carts have been rendered more suitable for work under modern conditions.

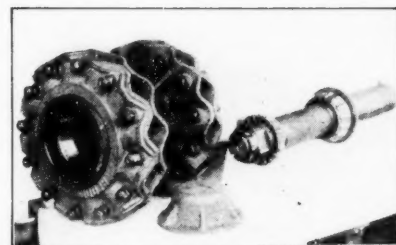
Trailers Carry Large Girders

SOME of the largest steel girders ever fabricated were recently moved on Rogers trailers at Bristol, Rhode Island, by the Callan Construction Company, who have a sub-contract on the Mount Hope bridge between Bristol and Portsmouth, R. I. The bridge when completed will be over a mile in length and one of the longest cable suspension bridges in the country.

The girders came in pairs ranging from 140 feet to 150 feet in length and weighed 76 to 80 tons each. Four flat cars were required to transport each pair over a special route from the Bethlehem Steel

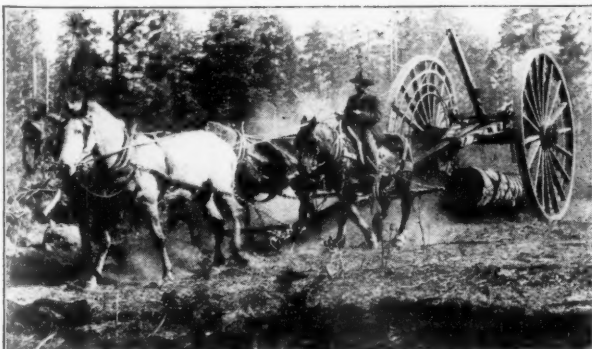
Works to Bristol. Two 20-ton steam cranes with a crew of nearly 20 men unloaded and reloaded them onto the trailers on which it was necessary to build a supporting deck of 14 by 14 inch timbers, high enough and strong enough to support the weight and also allow the girders to pivot on corners. On top of this deck, crosswise of the trailer, was a balancing timber 20 by 20 inches by 15 feet long, and on each end was attached the lashing cable which passed up over the girder and was tightened with two-inch turn buckles. These were to prevent tipping and to act as stabilizers.

It was necessary to pull the trailers nearly a thousand feet and use 10,000 feet of three-inch plank to fill in between railroad rails to allow travel over rails in the



Tapered roller bearings and steel hub of modern, swift, logging carts

freight yards before reaching the main highway. A five-ton Mack truck with platform body using two 14 by 14 inch timbers lashed lengthwise to the body with a 14 by 14 inch timber bolted crosswise of these two on the front of the truck served as a means of pushing the front trailer backwards and steering it, while two five-



Photographs courtesy Timken Roller Bearing Company

The creaking logging cart of yore. The bearings(?) on these were of wood; hence small loads were carried



Up-to-date transportation of logs from the forest to the lumber mill: cart with roller bearings, pulled by tractor



The way in which one man beat the cheaters. An invention for weighing coal as it is deposited in the cellar from a truck, to prevent short weight

ton Sterling trucks pulled from the front of the other trailer in getting onto the highway. The time in moving the first 1000 feet through the freight yards was about three hours, since telephone wires, trees, and curves required great care and patience, a false move meaning disaster. After reaching the main highway the Sterling trucks were placed ahead and the Mack used behind to help in steering and braking the load.

The total distance traveled was about two and one half miles and took between five and six hours. The trailers were the heavy duty, 28 ton, six-wheel, rubber-tired, gooseneck type with full fifth-wheel, spring-mounted front wheels. The four rear wheels are mounted on two pivoting axles with three-inch bridge at rear with Timken tapered bearings in all six wheels. The trailers showed no deflection under load and were not affected in any way. No tire trouble of any sort was experienced and the tires have been in constant use ever since.

Checking Up on the Coal Man

MAX GORDON, an insurance man, arrived home one evening and looked skeptical when Mrs. Gordon told him a ton of coal had been delivered at the house that afternoon. With a basket and a small

scale he spent the evening reweighing that so-called ton and by bed-time he found it was 350 pounds short. The coal company would give him no satisfaction; neither would the city's department of weights and measures.

Every time thereafter that he bought coal he felt he was being swindled. His neighbors felt the same way about it, but none of them knew what to do about it. Gordon set out to solve the problem for all of them. He devised a sort of hopper through which the coal would pass in its course of being chuted from a coal truck to a cellar bin. Nothing like it had ever gone through the Patent Office and a patent was issued in short order.

The device is simplicity itself. A rotating drum is mounted on a support. In this drum are a number of partitions radiating out from the center shaft. The coal pours into one of the sections formed by the partitions until it fills up. When the section is full it becomes unbalanced and rolls over, spilling the coal out the other side and into the chute leading into the coal bin. As one section turns over to spill the coal into the cellar, another comes up into position to receive the coal coming from the truck. A predetermined number of sections full of coal make a ton.

Gordon called the device an automatic coal reweigher and formed a corporation

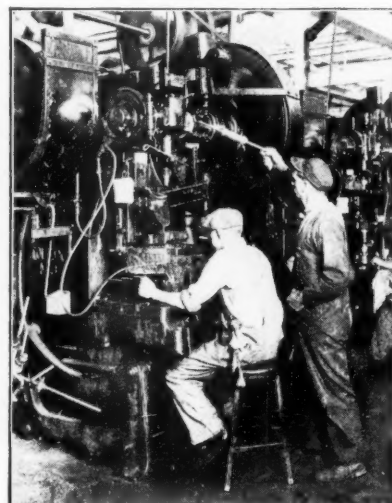
to direct its manufacture and sale. His neighbors hail it with delight, declaring that at last the day has arrived when they can be assured that they are getting their money's worth. To the inventor's surprise, however, the coal companies welcome the invention, declaring that now their customers can have no grounds for making ridiculous charges about being short-weighted.

Systematic Industrial Lubrication

ROMAN chariot wheels were drilled at the hub with an open hole for water or animal greases which were used as lubricants. Today this method of lubrication is still quite common in industrial plants, an inefficient open hole often serving as the only method of lubricating pulley bearings or shafting.

The announcing of drive fittings for all open oil holes by the Alemite Manufacturing Corporation promises a new era of lubrication in factories.

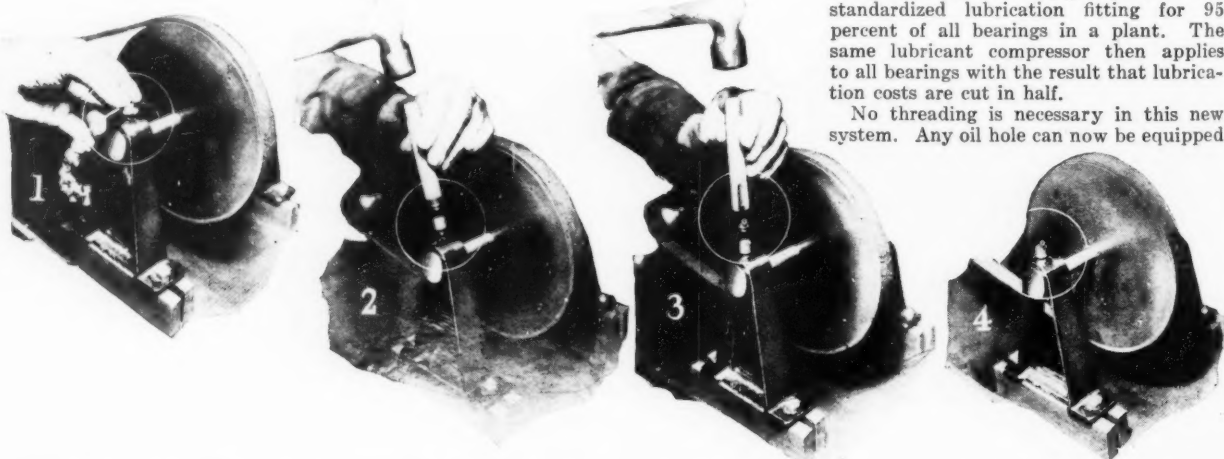
By placing high-pressure fittings in open oil holes, plant lubrication is standardized so that triple and quadruple lubrication including grease cups, oil cups, bottle



Industrial lubrication by means of a "gun" like those used on cars

oil, oil holes, et cetera, give place to one standardized lubrication fitting for 95 percent of all bearings in a plant. The same lubricant compressor then applies to all bearings with the result that lubrication costs are cut in half.

No threading is necessary in this new system. Any oil hole can now be equipped



Installing a drive fitting, for pressure lubrication, in the oil hole of a pulley bearing. In number 1, the operator is gaging the size of the present oil hole; in 2, he is driving

a feather-edged bushing into the hole, no drilling or reaming of the hole being necessary; in 3, he is driving a ball valve into bushing; 4 shows completed installation

with a high-pressure lubrication fitting, dirt-proof and permanently installed, in less than two minutes.

A reverse feather-edged bushing is driven into the open oil hole. These bushings are made in one sixty-fourth inch sizes from one eighth to onehalf inch. Special bushings are made for countersunk holes and for thin housings.

Into the top of the bushing a nipple with dirt-proof ball check valve is installed. An ordinary hammer and a set of three special drive tools form the complete equipment for installing this system in open oil holes.

The Alemite plant lubrication system provides for handling the lubricant from its original barrel to the bearing without exposure even to daylight. This system precludes possibilities for waste, unnecessary labor, or failure of the lubricant to reach the desired spot between bearing surfaces.

Disappearing Closet-Bed

DWELLERS in apartment houses are familiar with beds that fold up and tuck away into closets. Whether or not they have used them, they have seen these beds and no doubt noted that when the bed is opened out and made ready for the night, the door to its closet cannot be closed.

The mechanism of a recently invented disappearing bed is so constructed as to allow the door to be closed at any time—that is, when the bed is in the closet or when it is down. The door is swung on a vertical rod as shown in one of the accompanying illustrations in such a manner that, although when the bed is ready for use it covers half the door space, the door itself easily slides shut.

The new invention is manufactured by Marshall Stearns Company, of San Francisco.

Hearing the Eye See

PROFESSOR E. L. CHAFFEE, of Harvard University, has for some time been conducting experiments endeavoring to learn how the eye functions. Instead of attacking the problem psychologically as many have done, he has been following the methods of some early experimenters, namely Einthoven and Jolly, using a direct method of measuring the electrical changes

produced in the eye when light shines on the retina. He has considerably improved and developed the methods used by these early experimenters and has been carrying on these experiments since about 1921.

The eye of the animal is taken out and cut in two, thereby exposing the sensitive

is not the main purpose of the experiment.

The electrical changes produced in the eye consist in part of very rapid electrical vibrations and these vibrations, after passing through an additional amplifier, can be made to give out sound in a telephone. This leads to the interesting exper-



Professor E. L. Chaffee, who has been studying the eye, with the apparatus used in his experiments. With this apparatus he has heard the eye see

retina surface. Electric terminals, consisting of fine threads, are connected to this retina and to a vacuum tube amplifier which, in turn, operates a sensitive galvanometer and recording apparatus. When light shines on the retina, the galvanometer moves in a rather complicated manner showing that the light falling upon the retina sets up a complicated effect in the retina and the connecting nerves. He has been studying these complicated electrical changes in an endeavor to unravel the intricacies of the processes of vision.

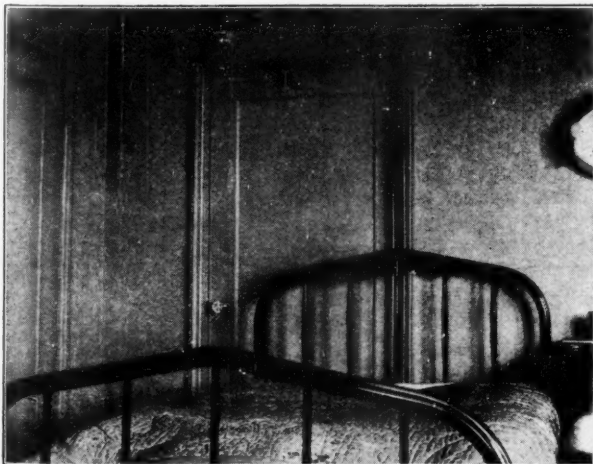
Although he and his associates have learned a great deal concerning the manner in which light sensations are transformed into nerve impulses and hence carried to the brain, their experiments have given so far very little aid to curing of troubles of the eye. One never knows the outcome of investigations of this sort and although it may be hoped that their results will be of benefit in diagnosing eye troubles, that

iment of being able to hear the eye see. This experiment is perhaps more sensational than useful.

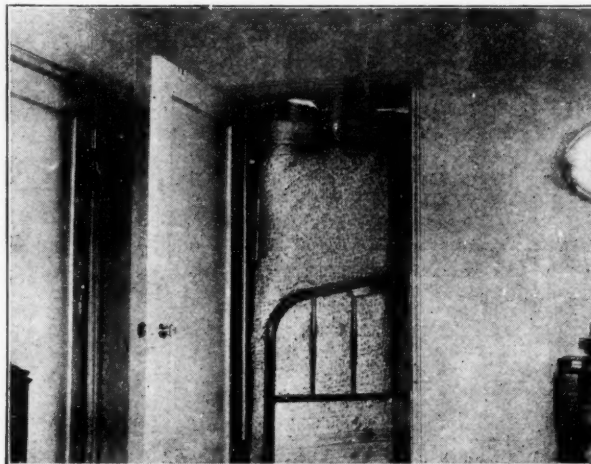
Professor Chaffee has been aided in this work first by Mrs. E. L. Chaffee and, during the last year and a half, by Miss Evelyn Sutcliffe.

Turtle Fossil Arouses Interest of Scientists

ONE fossil turtle, about a foot long, recently acquired by Field Museum of Natural History, has aroused intense interest on the part of distinguished scientists in three departments of that institution specializing in research along widely different branches of science, it was learned recently from Stephen C. Simms, director of the museum. The fossil turtle which is receiving so much attention is a gift to the museum from Mrs. Chauncey B. Borland, prominent Chicago society woman.



The new disappearing closet-bed. The door of the closet in which it disappears closes after bed is down



The disappearing bed folded away. In this photograph may be seen the vertical rod on which the door swings

The department of anthropology is concerned because on the back of the turtle, which was found in China, are six mysterious ancient Chinese inscriptions believed to have been carved on the shell almost 4000 years ago. Dr. Berthold Laufer, curator of anthropology and noted Orientalist, is engaged in deciphering the archaic script. The turtle was regarded by the Chinese as a sacred animal with the magical power of accurately predicting the future, according to Dr. Laufer.

The department of zoology is deeply interested because study of the fossil indicates that it is an entirely unknown species

The turtle will be placed on exhibition in the near future, after the inscriptions have been deciphered.

Aquatic Animal Remembers for Sixteen Generations

THAT "the elephant never forgets" is a favorite tradition of the circus lot and the zoo. But the big pachyderm's record has been badly scratched by a lowly animal that lives in the water, whose great-grandchildren of the 22nd generation remember a complex instinct possessed by their ancestor but which their more immediate fore-

very much, for it will not eat it except when its supply of stinging-cells is low. Then it swallows hydra readily enough, and appropriates the ready-made cells.

The two experimenters grew a strain of microstomum for 22 generations, without ever giving them an opportunity to meet and feed on hydras. Yet at the end of that time the animals went through the same performance their ancestors had been used to: swallowed the hydra, turned over the stinging cells to certain wandering cells of their own bodies, and eventually set them in order among their own stinging cells. In another case, a 16th generation microstomum had its upper and lower ends cut off. The middle third of the body regenerated new ends, and the "revised" animal went through the long-disused performance as though it had been used to it all its life.—*Science Service.*

Royal Photographic Society's Annual Exhibit

THE 74th annual exhibition of the Royal Photographic Society of Great Britain will be held this year from September 14 to October 14.

The secretary wishes a strong American representation, since active support from representative scientific workers in this country contributes largely to the success of the exhibition.

Exhibits intended for the scientific section may be sent to the Eastman Kodak Company, Rochester, New York, in care of Mr. Alexander Murray, and should reach him not later than July 15.

Eighty-four Elements in Single Collection

SHORTLY after publication of an article in our February issue entitled "Best Collection of Rare Gases," Mr. Edward S. Candius of the Brooklyn Edison Company, Inc., wrote us relative to a collection of chemical elements he has made. His comments are so interesting that we quote below a part of his letter:



Looking like a simple piece of stone with a peculiarly marked, dome-shaped top, this large fossil turtle aroused the intense interest of three departments of a great museum. It is covered with Chinese inscriptions dating back, it is believed, 4000 years. Study of it indicates that it is of an entirely unknown species

Courtesy Field Museum of Natural History.

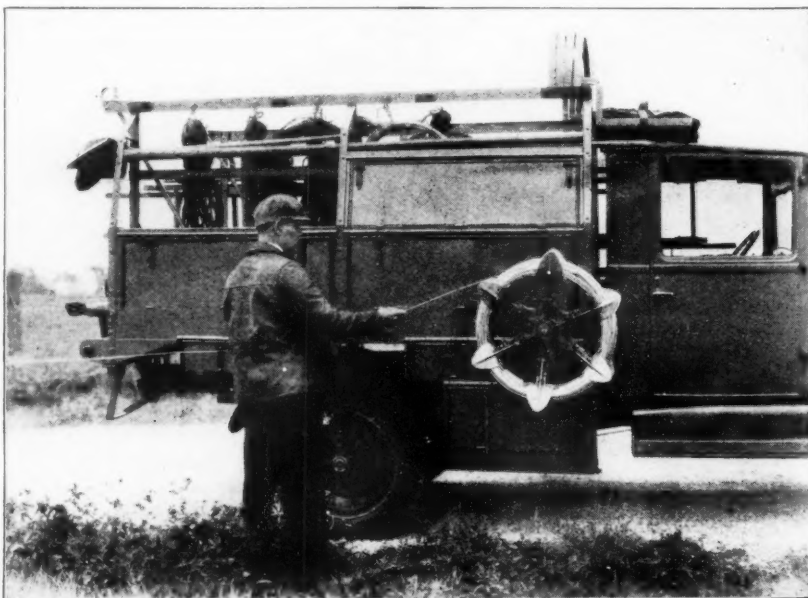
of the genus *Testudo*. There are no zoological records in existence of any other turtle of its identical species, it was determined after an investigation by Karl P. Schmidt, assistant curator in charge of reptiles and amphibians. Mr. Schmidt made a thorough examination of the specimen before his recent departure as scientific leader of the Crane Pacific Expedition of Field Museum. Paleontologists in the department of geology are likewise interested because their study of the turtle indicates that it lived in the Miocene epoch some 19,000,000 years ago. Like the zoologists, paleontologists have no previous record of a fossil of a turtle of its species, according to Professor Elmer S. Riggs, associate curator of paleontology.

Apparently, millions of years after the turtle's death, its fossil turned up to attract the attention of some Chinese mystic, who carved the inscriptions on its back, says Dr. Laufer. The turtle was found in Shensi province, China, and was brought to this country by C. F. Yau. The inscriptions, delicately traced, are in the earliest stage of Chinese script, identical with that on the famous oracle bones of Ho-nan. At a very remote period the shell of a turtle was one of the chief elements in the art of divination in China, declares Dr. Laufer. For this purpose, shells were scorched over a fire, and the cracks occurring yielded a picture believed to foreshadow future events. The oldest examples of Chinese writing are preserved on tortoise shell fragments which contain questions addressed to soothsayers and the answers given by them, Dr. Laufer states.

"Divination was one of the dominating influences in ancient Chinese life," says Dr. Laufer. "The diviner was not a priest, but his position was comparable to that of a lawyer in our society. In the same way that the modern business man consults his lawyer on important questions, the Chinese did not make a step without asking the advice of a diviner. The oracles and sometimes the questions were carved on bones, turtle shells, and other such objects, many examples being extant."

bears have never had an opportunity of exercising.

At the meeting of the American Society of Zoologists in New York recently Prof. W. A. Kepner presented the results of experiments which he and J. W. Nuttycombe, now of the University of Tennessee, performed on a tiny, almost microscopic, animal known as "microstomum." This creature is one of the many in the lower realm of nature that is armed with stinging cells in its body wall, partly for protection against its enemies and partly to assist in the capture of its prey. In the fierce economy of the lesser world of the waters, this animal feeds on a similar but smaller form, the hydra, which is also armed with stinging cells. It apparently does not like the hydra



A new collapsible power reel of aluminum or steel, recently announced by the Highway Trailer Company, Edgerton, Wisconsin. It collapses to permit placing or removing a coil of wire or rope. The winch takes power from the motor of the truck. It is used for pulling in aerial or underground cables

"Two years ago I started collecting for educational purposes the known chemical elements. To date I have succeeded in procuring specimens of 84 of the 90 known elements. Included among the 84 are specimens of pure krypton and xenon sealed in special tubes. These tubes were made up and given to me, along with tubes containing nitrogen, oxygen, argon, hydrogen, neon, and helium, by the Air Reduction Sales Company.

"You will gather from the enclosed copy of their letter to me and the accompanying instruction sheet [Not reproduced—Editor.] that krypton and xenon are now available from the atmosphere on a commercial scale in the United States.

"Spectral tubes containing krypton and xenon may also be seen on display at the American Museum of Natural History in New York City.

"However, this should not detract from the glory of research workers out west because it was necessary for me to go all the way to one of our great mid-western universities for pure specimens of metallic praseodymium, neodymium, yttrium and lanthanum, and salts of thulium, terbium, dysprosium, holmium, hafnium, samarium, gadolinium and ytterbium."

It is doubtful if there exists in this country and perhaps in the world, a collection equally as complete as this one.

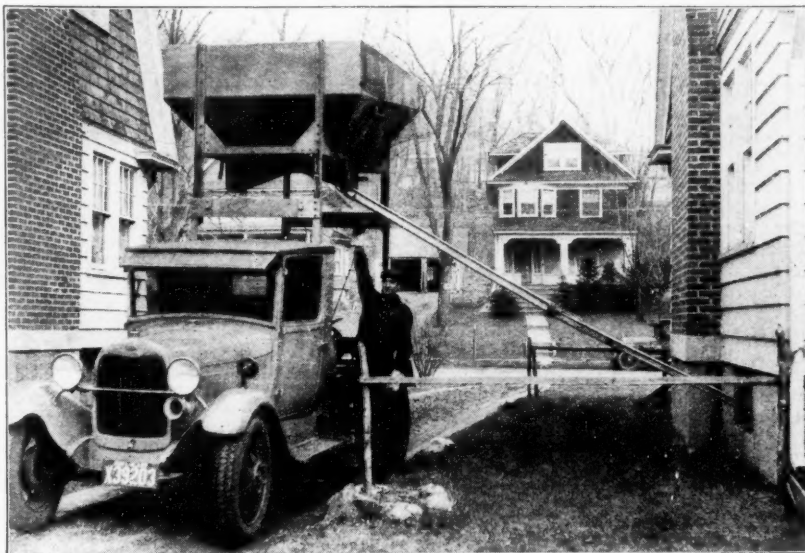
An Elevating Coal Delivery Truck Body

COAL dealers, especially in small or suburban towns, are often faced with the problem of delivering coal from a narrow driveway into the cellar window of a home. Usually it is practically impossible to back up a rear-delivery truck so that the coal may be delivered through a chute, thus necessitating delivery by means of a shovel or in baskets.

A new delivery body for Fords, Chevrolets, or other light duty one-ton to two-ton trucks, announced by the Thomas

cellar window and elevate the body to the necessary height. The body is hoisted either by hand or by a power hoist or by both. If raised by hand, one man can perform the operation in a minute and a

But now, when the fuel tank goes empty on the road, just remember there is enough gas soaked away in the car's iron and steel to run it for miles. A few old stove lids or grate shakers contain enough fuel to boil



Elevating delivery body which was especially designed for coal trucks. The body is staunchly built and may be used on the chassis of a small truck

half. The body is made of a special rust-resisting steel. Each body is equipped with one dividing board for two single tons, one two-section galvanized chute, and a basket board. The hoist frame is made of heavy angle iron.

Scientist Squeezes Gas Out of Iron and Steel

PEOPLE who live in wooden houses can always chop down a door or a partition to keep warm, but until now, ham

the morning coffee or fry the ham and eggs. *The trick is to get it out.*

N. A. Ziegler, scientist in the Westinghouse Research Laboratories, can do it. He squeezes fuel gas out of iron and steel like water from a sponge.

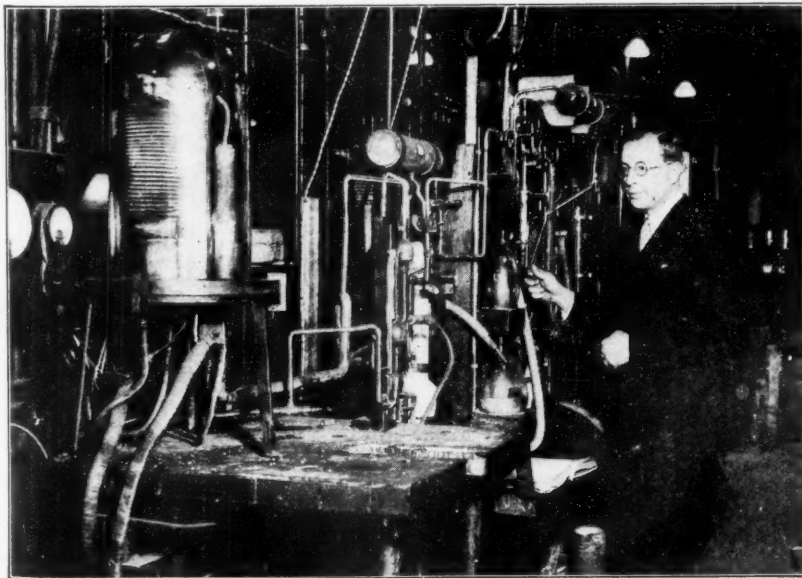
An old automobile piston, for example, gives up 33 times its own volume of fuel gas; wrought iron and steel give up gas in less amounts. This gas, which burns with a pale blue flame, can be used to operate a gas stove and, with proper carburetor adjustments, an automobile. A couple of cubic feet of cast iron gives enough gas to furnish about ten horsepower for twelve minutes.

While automobiles have usually been operated from liquid fuels, it will be remembered that during the war, motor cars in England and France were operated from gas in bags. Even now there are trucks running in Europe and South Africa, operating from a similar fuel gas made from coal in a little producer on the truck.

The iron from which gas has been squeezed has a brilliant, lasting sheen, instead of the dull rusty surface common to cast iron. It is better for making magnets than ordinary iron. This is the principal value of the process, the inventor thinks, since, at present, the cost of getting the gas is far greater than its value as a fuel. Better iron for electrical machinery, however, is very important, since millions of pounds are used annually and cheaper and better electrical machinery affects the public generally.

Mr. Ziegler uses a big high-frequency induction vacuum furnace for extracting gas from cast iron. A powerful vacuum draws off the gases that boil out. The furnace quickly melts the hardest steel, but will not burn the hand nor scorch a cigaret paper.

The furnace is built of glass and, as the gases are drawn off, glows with a brilliant, soft blue light, believed to be the same in character as the Aurora Borealis, or Northern Lights.



Mr. N. A. Ziegler with the apparatus which he has developed for extracting gas from ferrous metals. By his process he obtains pure iron and steel

Wright Company, of Jersey City, New Jersey, elevates vertically and delivers from the side. With this body it is simple enough for the coal truck to drive into any narrow driveway, install a chute to the

and eggs could never be cooked with a leg of the kitchen range, nor was it possible for marooned motorists to run the "gasoline wagon" with a spare wheel or a set of fenders stripped from the car as fuel.

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

An Interesting Light Plane

DESIGNING an airplane is not entirely a matter of consulting one's inner consciousness and evolving a perfect design therefrom. It is advisable to study magazines of all types to see what other people are doing, to visit flying fields and air shows, to fly with an eye to useful observation, to talk with pilots, to talk with passengers and laymen who are users of planes, et cetera. For example, we will study the specifications and photographs of an interesting light plane, the *Starwing*, built by the American Aircraft Corporation. This is a low wing two-seater, equipped with the Le Blond 60 horsepower, five-cylinder, air-cooled engine. Every line of the description can be studied usefully.

Being light in weight, one man can easily handle it around the hangar, but still it is large enough and heavy enough for perfect riding comfort. Its total wing span of 29 feet permits housing in a small inexpensive hangar.

These are good points. If private planes are to become popular, they must indeed be easily handled and housed.

Tandem seating arrangement is used, since this gives more room for the pilot and passenger, lessens the chance of interference with the pilot's operations and makes long trips more comfortable. The cockpits of the *Starwing* are only six inches narrower than the latest type side-by-side seating arrangements of other types of airplanes.

We are not so sure that for sport planes the tandem arrangement is the best. Surely for companionship and perhaps also for ease of instruction, side-by-side seating has some advantages. But we do like the comfortable width of the cockpit, if this can be attained without undue sacrifice in weight and aerodynamic resistance.

All cowling is removable, exposing the entire motor, gasoline tank, and all necessary connections.

Any one who has worked around a car or an airplane will appreciate this. It is hard enough to get things right when they are entirely visible. It is far harder to work by feel alone.

The wings are attached to the lower edge of the fuselage, independent of each other, and externally braced with sturdy V-type compression struts, located in positions that eliminate climbing over them when entering the cockpits. Each wing

being an independent unit, replacement costs are greatly reduced.

To this a number of criticisms can be made. A wing continuous under the fuselage is somewhat cheaper to build, in the first place, and is also somewhat stronger for the same weight. Still, there is a good deal to be said for the independent unit idea. The side view illustrates clearly how easy it is to enter the cockpit, and this will appeal to any one except the youngest and most agile air traveler.

The landing gear of the *Starwing* has a nine-foot tread and is placed directly under the external wing bracing. It has been proved that this type of gear enables the ship to be easily handled on the ground, and controlled in cross-wind landings, having no tendency to ground loop. By placing the wheels exceptionally far ahead of the center of gravity, the danger of nosing over is practically eliminated. The position of the gear makes a tail-high landing practically impossible, since the tail is forced down as soon as the wheels touch the ground.

It is indeed one of the advantages of the low-wing monoplane that it is possible to use a very wide tread landing gear, without any clumsiness in the design. A high-wing monoplane has its width of tread limited by the fact that the landing gear struts must go to the fuselage, and if the wheel tread is very large, either the struts must go to the upper wing and become unduly long and heavy, or else the strength of the landing gear is seriously impaired. Of course the high-wing monoplane is likely to be a little more stable than a low-wing job. If a low-wing job turns over on its back in a rough landing the occupants may be seriously injured, whereas with a high wing, they are protected by the wing itself.

The reader will see from these facts that no one type can be made to combine all the possible advantages. It is very desirable to put the landing-gear wheels far ahead of the center of gravity, from the point of view of safety. But when the wheels are far ahead of the center of gravity, it is difficult to lift the tail off the ground on making a get-away. It is advisable in such cases to have very powerful elevators, and even then, the get-away is apt to be a trifle slower than when the wheels are at a more reasonable distance ahead of the center of gravity.

The photograph of the front of the air-

plane shows the excellent way in which the landing gear structure and the wing bracing work together.

In the side view we note the neatness of the nose and cowling, and the excellent all-around vision of the man in the front seat.

Another point that the description of the *Starwing* stresses is that the fuel feed is entirely by gravity. Unfortunately, this means that the tank is placed just behind the fire wall, and immediately ahead of the front occupant. This is not, perhaps, the best disposition from the point of view of fire hazard. In a high-wing job, the fuel can be placed in the wing away from the cockpit, and not in line with the engine, so that fire hazard is probably lessened. A better arrangement, from the fire hazard point of view, would be to place the fuel in the wing of the low wing job, but this means the introduction of a fuel pump, and a little complication.

What makes plane design so interesting, and at the same time so irritating, is this necessity for compromise and the apparent impossibility of getting every point just right.

Practical Flying

MAJOR BYRON Q. JONES of the Army Air Corps is one of the first pilots the army ever trained, and he has viewed aviation from many angles, including instruction, personnel, engineering, and tactics. His book "Practical Flying" (published by the Roland Press) is an authoritative and attractive treatise on this subject, which will be invaluable to all students and prospective private owners.

A man can learn to solo in a few hours, at a cost of between two hundred and four hundred dollars, but Major Jones considers this to be only an elemental course. "A student just completing his elemental course is about as qualified to start off on his own, as is a country beginner in auto driving to undertake fast driving in congested city traffic." This is a timely warning.

Flying instruction should be of short duration. Thirty minutes at a time is recommended. Lengthy instruction periods fatigue the student and make him careless. The average man is advised to take only two hours instruction per week.

We have become accustomed to dual instruction, in which a pilot in the front cockpit signals to the student in the rear cock-



The "Starwing" is a light, two seater airplane which can be easily handled around the hangar by one man



This side view of the "Starwing" shows its clean lines, and the low-wing monoplane features described above

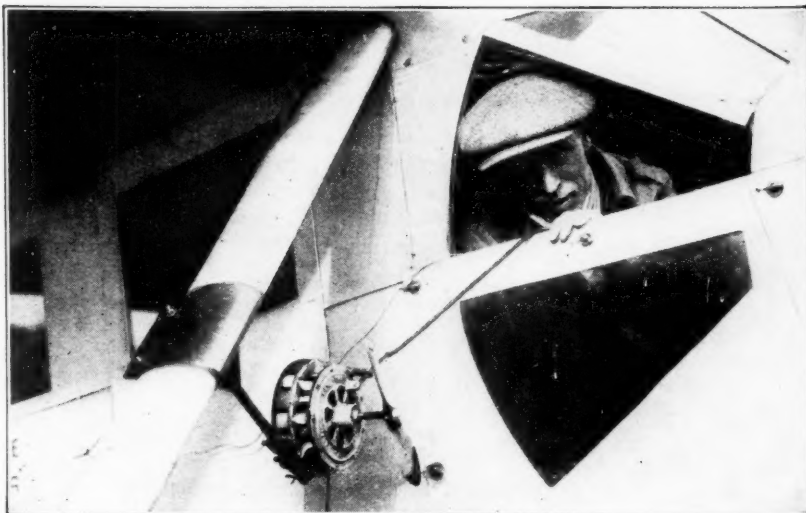
pit. This is the original Wright system. It is a curious reminiscence of old times to read of the Curtiss system, now long abandoned, in which the student was put into a single seater with only power enough initially to taxi along the ground. "When the student had become proficient in handling the plane on the ground he was given just enough power to get off the ground for a short hop." And so with gradual increase of power he would go through the entire course. Major Jones thinks quite correctly that a reversion to this early system would be costly, dangerous, and purposeless. Still it is curious to think how many excellent pilots were produced by this "self-help" method.

The book teems with real practical tips. The orthodox, open-cockpit plane will soon soil a man's clothes. Mechanics climb in and out of the cockpits with dirty shoes and greasy clothes, soiling the cockpit. The exhaust and oil thrown by the engine may help in the dirtying process. The beginner must be prepared to ruin a suit of clothes or to wear overalls. Gloves are not necessary in summer. Warm, fingerless gauntlet gloves are best for winter. A good fitting helmet is necessary and should be provided with large "powder-puff" ear muffers sewed on the inside.

The answer to the question "Can anyone learn to fly?" is that the average normal person who *wants* to fly can learn to fly. But there must be a real sub-conscious desire to fly.

Too much concentration is harmful. In the old bicycle riding days it was a common experience that if a beginner fixed his mind upon an obstacle he was afraid of running into, it was almost a certainty that he would do just that. Erroneous concentration, in Major Jones' opinion, is responsible for 90 percent of our flying accidents. The pilot must be on the alert but should not concentrate on the possibility of trouble.

Do you ride a horse mechanically or do you adapt yourself to its natural rhythm? In driving a strange car do you force it, or learn to adapt yourself to its peculiarities?



Showing the location on the side of the fuselage of a wind-driven siren which sends out a note which operates apparatus to light the airport automatically

These questions settle your adaptability and hence suitability as a pilot.

If we quoted all the interesting and valuable information conveyed by Major Jones we should have no space for anything else in our columns.

Lighting a Field Automatically

THE Westinghouse Electric and Manufacturing Company has developed a "robot" which is likely to be of real service in keeping down the operating expenses of airports, because it will turn on the lighting system of an airport only when needed—when a pilot is about to make a landing at night.

At the side of the plane there is mounted a siren operated by a wind-driven propeller. When the pilot releases the brake of the siren, its piercing scream acts on a sensitive pick-up on the ground which, in turn, puts into action the electric lighting system. The siren can be set on a note of

any given frequency so that other noises are not likely to set the apparatus into action. The sound-sensitive apparatus is also a part of Televox, the "mechanical man" invented by Roy J. Wensley. Recent tests made at the Newark airport have been successful.

"Airmen or Noahs"

A RECENT English book, by "Neon," entitled, "The Great Delusion," attacked all flying in a spirited and literary fashion, but it was marred by mis-statements and exaggerations. We were glad to read an effective rejoinder in "Airmen or Noahs" by Rear-Admiral Murray F. Sueter (published by Isaac Pitman and Sons, New York).

Apart from its controversial value, "Airmen or Noahs" gives a vivid and interesting survey of all flying matters, and will appeal to almost every layman and to many technicians. We particularly like the treatment of naval aviation, and the discussion of its utility as a means of attack. The conclusions of this careful and erudite author are particularly striking.

"The truth of the whole matter is that we must educate the youth of this country (England) in the advantages to be gained by this nation in air development, particularly in regard to communication and air travel. . . . At present there are no exact flying statistics available. But what there are, show that in the last two years air travel has been much safer than generally realized. This safety is year by year increasing, whereas that of road travel, due to the very large number of motor-bicycles, motor-cars, lorries, et cetera, on the road, would appear to be decreasing."

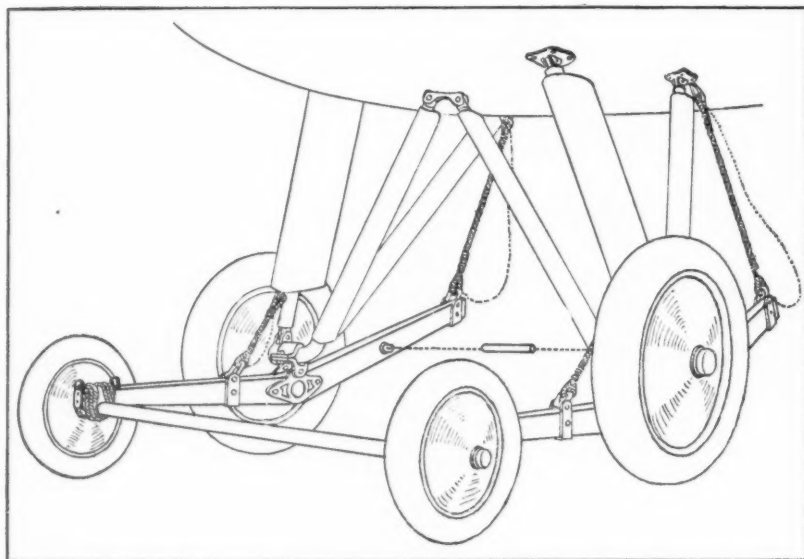
How well these remarks apply to the United States!

The Ideal Sport Plane

THE announcement of the Light Plane Prize of the SCIENTIFIC AMERICAN was naturally in the form of an official statement, and the committee could not voice its sentiments as to the exact character of an ideal plane. It was far better to state that a design for an ideal light plane was desired, and let it go at that. But it may be of interest to possible entrants to quote from an editorial in *Aviation*, whose staff



Quite a number of accidents have occurred at airports, in which passengers or visitors have walked into rapidly whirling, and therefore invisible, propellers, with disastrous results. This photograph shows an idea which may prove to be a useful safeguard against this danger. The end of the propeller is painted with colored stripes which attract the eye when whirling



Drawing shows the component parts of the Fritsch landing gear described below

has been giving serious consideration to the requirements of the light sport plane. As a result of their study, they make the following recommendations.

The light plane should have the high speed of a Lockheed Vega (somewhere around 140 miles per hour), the slow landing speed of an Avro (say 35 miles per hour), and the quick take-off of a Waco 9, powered with a Whirlwind engine. It should have the maneuverability of a Curtiss pursuit, the inherent stability of an Arrow Sport, and the long life of a "Jenny" (that is to say, the well known Curtiss JN-4).

It should be an amphibian, and although normally seating two people, it should have an extension feature which would give it the carrying capacity of a Ford transport. The forward and down vision should be similar to that of the early pusher types, and the vision to the rear should be unobstructed. The engine should be of low power, preferably with four cylinders, and preferably it should be of the Diesel type.

It is a little too much to ask that this will be realized in the near future, particularly if the price of the plane is to be limited to two thousand dollars. Still there is nothing like visualizing the ideal, and then trying to live up to it.

The Fritsch Landing Gear

AT the recent New York Air Show, a model of the Fritsch landing gear was exhibited. It is a novel arrangement which has some possibility of increasing the safety of a training plane. The design is shown diagrammatically in one of our sketches. The apparatus consists of two auxiliary wheels, mounted at the forward end of two horizontal arms or levers, which are pivoted at their centers to the landing gear. The rear ends of these arms are jointed to the fuselage by rubber shock absorbing connections, and function only when the landing angle is abnormally steep. In such cases the auxiliary wheels come into contact with the ground first, so that there is a downward pull on the fuselage in the rear of the center of gravity. This helps to restore the plane to the proper landing attitude. When this angle is reached, the pressure on the auxiliary wheels is released and

the regular landing gear comes into use in the normal way. The purpose of the auxiliary landing gear, of course, is to decrease the dangers due to bad landings or uneven ground.

The action of this landing gear is further illustrated by three diagrams. In the first diagram, the airplane is shown landing at an extreme angle. There is, of course, danger of the plane nosing over. The second diagram shows how the pressure of the ground acting on the front wheels is transmitted as a pull to the rear shock absorber, and thus tends to pull down the rear of the fuselage. In the third diagram the plane is shown restored to its normal position.

The Fritsch landing gear is said to have been used successfully on a number of French training planes. Nevertheless, it remains to be seen whether designers will accept the device which adds to the expense, weight, and aerodynamic resistance of the airplane chassis.

Practical Training in Aviation

ADVANCED instruction in aeronautical engineering now has been placed on a very sound footing, thanks largely to the Daniel Guggenheim Fund for the Promotion of Aeronautics. Also, this type of instruction is more thoroughly understood. The student must have a solid foundation of mathematics, mechanics, and general engineering on which to base his specialized work in aerodynamics, design, stability, engines, et cetera.

Training for activities in aviation other than those of the technical engineer is in a much more uncertain condition. There are now many openings in the aviation industry for men, but they must be well trained. It is difficult for a man to break into aviation just because it has a romantic appeal for him, if he has no specialized knowledge.

The Department of Commerce analyzes the positions which may be obtained after proper training and experience as follows:

(1) Pilot. (2) Mechanic. (3) Aeronautical engineer. (4) Factory man. (5) Airport designer and constructor. (6) Airport ground man. (7) Radio operator. (8) Traffic agent. (9) Advertising and

publicity man. (10) Airplane salesman.

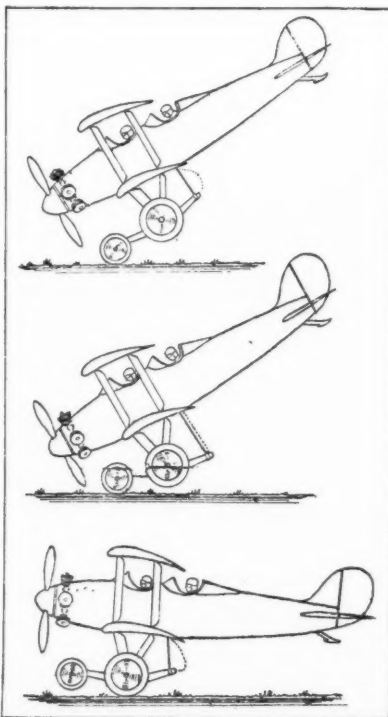
A pilot with several hundred hours of experience in all kinds of flying, including cross-country work, has plenty of openings at this time. There are fewer, but still there are some, openings for men who have had 50 hours solo flying. However their activities are restricted by the Department of Commerce. A man with a 50-hour license can carry passengers for hire only within a restricted area around an airport. Or he may engage in such flying operations as cotton dusting, aerial photography, et cetera. But he may not carry passengers or property for hire between states.

Pay for pilots varies. On most contract mail routes, pilots receive a base pay, with a percentage for miles flown with mail. Total earnings may run to 5000 dollars a year or more. Pilots operating at airports and carrying passengers up for short hops receive from two dollars to five dollars for each passenger.

Before enrolling in a training school, the student should take the Department of Commerce physical examination, so that he may receive a student permit.

Great care should be exercised in selecting a training school. Opinions should be secured from past or present students of the school. There is one criterion of a general character by which schools can be judged, and that is whether they conform to the air commerce regulations. Also, the best schools give as much care to ground training as to flight training.

The average training school gives 10



The action of the Fritsch landing gear when a plane so equipped lands at an extreme angle to the ground

hours of dual instruction, and one or two solo flights. But the man who expects a job after such short work will be sadly disappointed. He has only begun. He should put in 50 hours more before even attempting to carry passengers near an

(Please turn to page 470)

Industries From Atoms

Advance Made in Industrial and Experimental Chemistry

Chemical Effects of a Meat Diet

CLARENCE W. LIEB and Edward Tolstoi, of the Russell Sage Institute of Pathology, report the effect of an exclusive meat diet on the chemical constituents of the blood in the *Proceedings of the Society for Experimental Biology and Medicine*. The report says in part: "This is a preliminary report of an experiment to study the effect on human beings of an exclusive meat diet of several months' duration. Our subjects were two Arctic explorers who had spent many years within the Arctic Circle, and who, while there, had lived for the greater part of the time on a practically 100 percent meat-and-fat diet. Preliminary to our observations they were given careful physical surveys. Both were in excellent condition and showed no evidence of impaired health. Following these examinations, studies were made of the respiratory exchange, ketogenesis, protein balance, mineral metabolism, fecal bacteriology, hematology, and the chemistry of the blood. This report confines itself to the blood chemical findings."

"The data may be summarized as follows:

(1) Two healthy men who had lived exclusively on meat for eleven months, felt no untoward effects, maintained their weight, and were in excellent health. (2) We find no evidence of renal impairment. (3) The chemical composition of the blood is little affected, except for a slight increase in uric acid and a temporary lipemia. The latter occurred significantly and only after unusual amounts of fat were taken."

Improvements Modernize Sulfuric Acid Manufacture

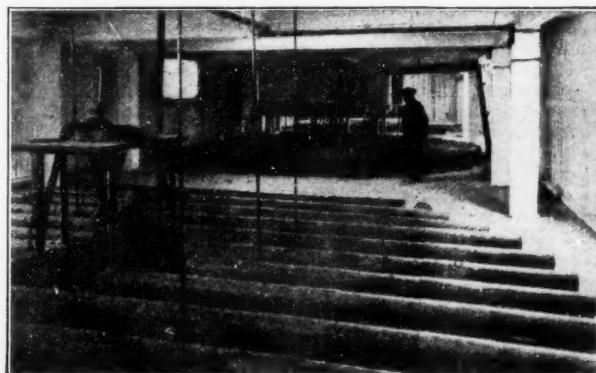
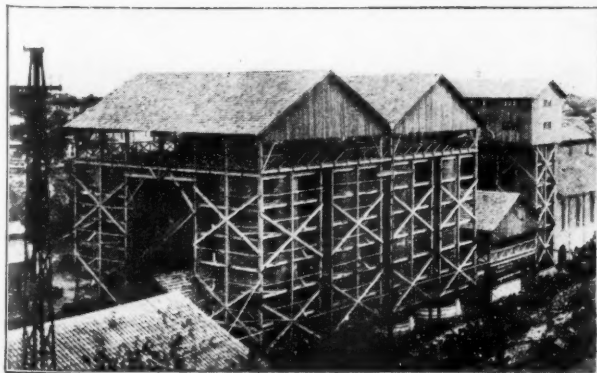
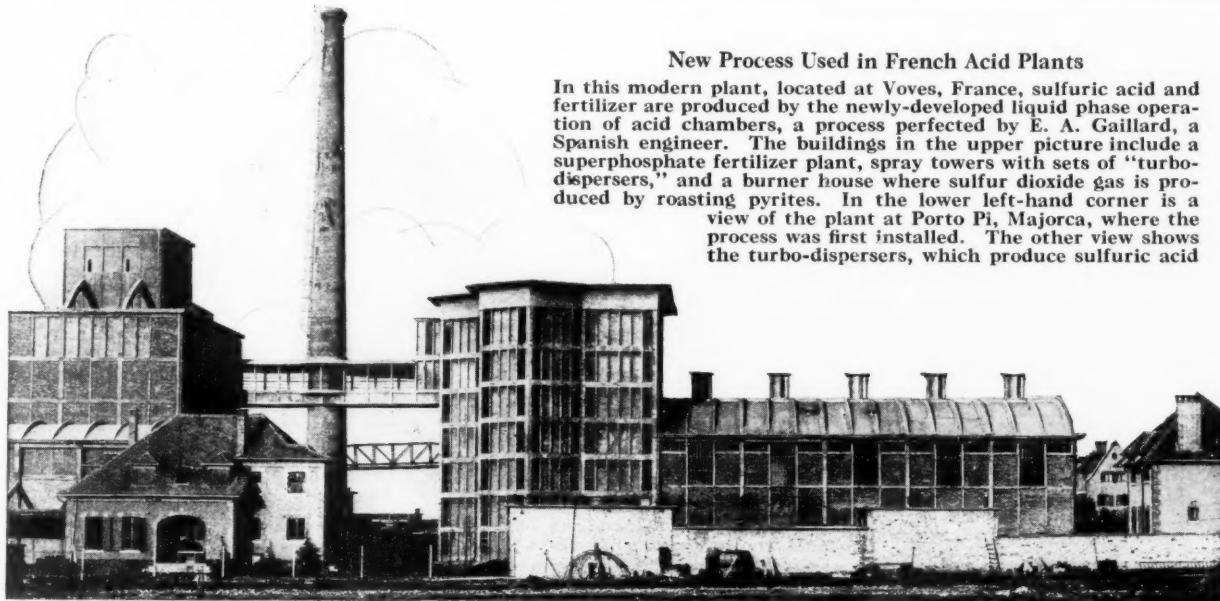
SULFURIC acid has long held its position as a key chemical, that is, it enters into practically every chemical process at some stage of the game. The acid is manufactured by two processes, known as the "contact" and the "lead chamber" process, the former being more economical for the production of concentrated acid (above 60 degrees, Baumé) and the latter holding its precedence for the more dilute grades, used largely in fertilizer manufacture. Improvements in the first, or catalytic process, have been made. Now comes a most interesting development in the older

chamber process, which indicates that it is keeping abreast of technical development and holding its own in the production of this vitally important chemical. Percy Parrish, a London chemical engineer, describes what he calls the "liquid phase operation of sulfuric acid chambers" in a recent issue of *Chemical and Metallurgical Engineering*. Roughly speaking, the distinctive point about this new process is that the sulfur dioxide gas, which is the first step of sulfuric acid manufacture, reacts with liquid acid instead of with other gases to form the desired H_2SO_4 .

It has been found that when sulfur dioxide gas is forced through liquid nitrous vitriol, which is agitated by known means, the rate of formation of sulfuric acid is abnormally high. This brought the idea of using the principle in acid manufacture, and accordingly, a Spanish engineer, E. A. Gaillard, developed an ingenious device known as a turbo-disperser for atomizing sulfuric acid within closed reaction chambers. Cold acid is projected in the form of a very heavy rain against the internal circumference of a tower chamber, forming a heavy mist which takes

New Process Used in French Acid Plants

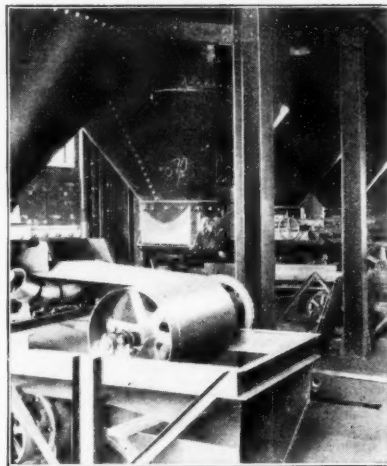
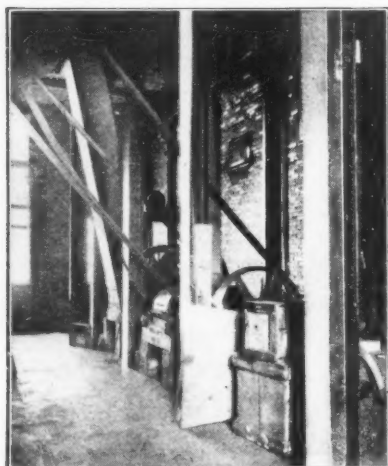
In this modern plant, located at Voves, France, sulfuric acid and fertilizer are produced by the newly-developed liquid phase operation of acid chambers, a process perfected by E. A. Gaillard, a Spanish engineer. The buildings in the upper picture include a superphosphate fertilizer plant, spray towers with sets of "turbo-dispersers," and a burner house where sulfur dioxide gas is produced by roasting pyrites. In the lower left-hand corner is a view of the plant at Porto Pi, Majorca, where the process was first installed. The other view shows the turbo-dispersers, which produce sulfuric acid





Chemical Engineering School

Prospective chemical engineers learn to conduct the important operations practiced in the largest chemical factories at this new experiment station (above), which is a unit of the University of Minnesota. The principles of gravity flow, and proper methods of grinding and crushing materials, are learned by the students using the crusher units shown in the picture at the left. Each unit is fed from storage bins above, and discharges the ground pulp to bins located on the floor below. The belt conveyors, illustrated in the picture at the right, contribute to the future chemical engineer's first-hand knowledge of up-to-date industrial practice. Few commercial plants are as well equipped as this "laboratory" at the University of Minnesota. The new building is to be used as a part of the Mines Experiment Station



up the sulfur dioxide gas much more efficiently than the usual lead-chamber, vapor-phase process.

One of the first plants erected was at Porto Pi, Majorca, in the Mediterranean, shown in the accompanying photographs. It produces 50 tons of 53 degrees Baumé strength acid per day. Other installations have followed, establishing the efficiency of this radically new development in one of the oldest of chemical processes.

Nutritive Value of Iodine

IODINE, as commonly recognized, is not recommended as an item of diet, for in the "tincture" form, or alcoholic solution, it is distinctly unhealthy. In combination with other elements, and in strictly limited doses, however, iodine has beneficial effects on the human system which can not be ignored in the light of recent research.

Drs. Orr and Leitch of the Rowett Research Institute in Scotland, have demonstrated that the effect of iodine on plants depends on dosage. The yield of radishes grown in a control plot to which no iodine was applied was 3240 grams per square meter; with an iodine dose of 0.05 grams per square meter the yield was 5400 grams, but with a dose of 0.5 grams per square meter the yield fell again to 4200 grams. In tests with peas grown in culture solution it was found that the addition of iodine to the extent of 0.0001 gram per liter was accompanied by an increase of from 5 to

10 percent in the weight of plants. The addition of 0.001 grams, however is followed by a decrease in weight of about 30 percent, and the toxic effect rapidly increased with increase of concentration of iodine above that level.

Experiments with pigs show that where a small dose of iodine was given, the average gain per pig per day was 1.55 pounds, whereas pigs which had not received the iodine gained 1.37 pounds. But when the dose of iodine was increased, the pigs not receiving the iodine did the better.

Experiments in Switzerland have shown that boys receiving potassium iodide grew on an average of 0.7 centimeter more than untreated boys, and put on 0.2 kilogram more in weight. The treated girls grew on an average of 0.4 centimeter and put on 0.1 kilogram more weight than the untreated girls. It has been found that the mean weight at birth of infants of mothers using iodised salt was about 100 grams higher than of those of not using iodised salt.

White Bread Holds Popularity

THE staff of life is strong enough to hold its place on American tables for some time to come, according to Dr. Walter H. Eddy, in a recent issue of the *Baker's Weekly*. Discussing the use of whole wheat versus white flour, he points out that there is a willing tendency to accept the whole cereal in many forms as a breakfast ad-

junct. A decided preference for white flour bread persists despite all arguments as to its deficiencies. The development of milk breads is a direct response of manufacturer and consumer to education in regard to white flour deficiencies.

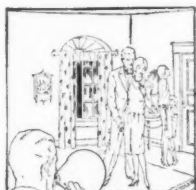
It does not follow, because a foodstuff is not in itself a complete diet, that it is thereby useless or necessarily harmful. Analyses show that graham, entire wheat, or rye breads made with water are all distinctly better sources of iron and phosphorus than white bread made with either water or milk. Tastes differ. White bread may well find a perfectly satisfactory place in a menu in which incomplete foods are properly supplemented.

Tri-sodium Phosphate, By Any Other Name, Won't Clean Any Better

FAR be it from this department to give away valuable trade secrets, but a number of our friends have been surprised and pleased to learn that the wonderful new cleaner they had discovered at the grocers was nothing more than a familiar chemical which had acquired a trick name. According to the United States Tariff Commission, the use of tri-sodium phosphate is rapidly increasing. It is valuable as a water-softener and as an emulsifier of grease. Its widest use is for general household and industrial cleaning, especially where non-abrasive material is desired. For household consumption a large per-

Romance or reality, movie studios or factories ...there this grainless wood

In moving picture studios the strength and lightness of Masonite Presdwood, combined with its ability to take any finish, make it the chosen material for set building. In industry the same qualities lower production costs and make manufactured articles better. Perhaps you, too, can use it to advantage. May we send you samples to try?



FOR SCENES IN
THE MOVIES

A king's palace today—a rustic cottage tomorrow. To Masonite Presdwood, as used in the leading movie studios, it is all in the day's work, for so sturdy is this beautiful grainless wood that moving picture producers find they can use the same pieces again and again—in scene after scene.

But this versatile actor, Presdwood, plays equally important industrial roles. Today a shipment goes to an automobile body plant to be used in motor truck side panels. Tomorrow a carload is routed to another factory where children's toys are being turned out by the thousand. In fact, there seems to be no limit to the wide range of uses for this attractive paneling material. And alert production managers are continually finding new ways to use it in improving their products or lowering the cost of the articles they manufacture.

Unlimited Uses in Industry and Building

Presdwood is used for the ceilings of railway passenger coaches, for the backs of theatre seats, in automobile bodies and speed boat decks and hulls. It makes light, strong, splinterless shipping containers, decorative folding screens, bass and snare drum shells, table tops, kitchen

cabinets and many other familiar objects.

In building, it is used for interior paneling, for house and office partitions and for the lining of closets, attics or elevator shafts. It is specified for the surfacing of concrete and masonry forms. And because it is easily sawed or cut and does not split, it is ideal for the man at home who puts up shelving or for the mechanic who builds a doll house.

Eliminates Waste and Expense

Since it is free from knots, checks, or cracks, Masonite Presdwood reduces waste and cuts expense to a minimum. And because it is made from natural wood, with no artificial binding material, it cannot possibly harm valuable tools and machinery.

New methods and up-to-the-minute materials will bring profits to your business. Masonite Presdwood is wood in its most modern form.

Investigate its money saving possibilities. Your request will bring a generous free sample by return mail.

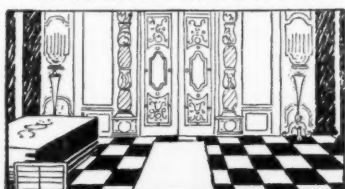
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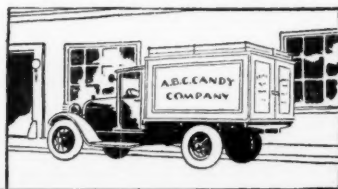


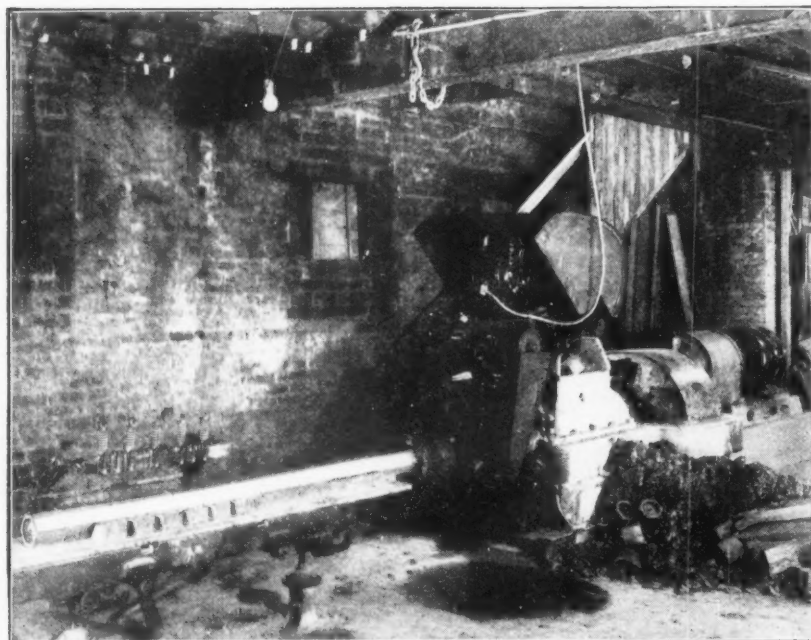
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Mills: Laurel, Mississippi

Masonite
PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR MOTOR TRUCK PANELS





This machine extrudes a continuous strip of "hexahelix" blocks, ready to be cut into the proper length and fired. The blocks are used for absorbing gas

centage of the total production is put up in small packages under various trade names. Some of these brands consist of tri-sodium phosphate only; some contain borax, soda ash, and other ingredients. For industrial cleaning, large quantities of tri-sodium phosphate are sold by the barrel to hardware manufacturers, automobile makers, garages, bottling works, restaurants, hotels, packing companies, dairies, and railroad companies.

In laundries, it is used to soften hard water and to remove stains left on goods during previous washings. In the paper industry, considerable quantities of it are used for cleaning felts and as a casein solvent. Minor uses are (1) as an ingredient of boiler compounds to remove boiler scale or to prevent its formation; (2) in the manufacture of tri-calcium phosphate used in tooth pastes and in free-running salt as a stabilizer; and (3) in the preparation of paint removers.

Mineral Pigments to Be Studied

A PROGRAM of investigation which promises to assist in the development of a substantial American industry in a field hitherto largely neglected is the study of the ochers and mineral pigments of this country being conducted by the United States Bureau of Mines. This study, which was first concerned with the ochers and mineral pigments of the Pacific northwest states, is being extended to cover all the known ocher deposits in the country. Co-operation has been obtained from most of the state geological departments, and they are collecting samples and studying the occurrence of the pigments in their respective states.

The value of an ocher depends principally on its color and the closer it approaches the golden yellow hue of the French ocher, the greater is its value. When the original sand and impurities have been removed by washing in water, the ocher should have an impalpable fineness and an iron oxide content of 17

percent or more, and should be able to retain a large portion of its color strength when diluted with zinc oxide.

All interested parties are invited to send one-pound samples of ochers or other pigment materials to the Northwest Experiment Station, United States Bureau of Mines, Seattle, Washington, for preliminary classification tests.

Ingenious Device Improves Absorption Process

MANY chemical processes require the absorption of gas by a liquid. This is generally accomplished by passing the gas up through a tower packed with bricks or "rings" over which the absorbent liquid trickles. The greater the surface of liquid exposed to the gas, the more efficient the absorption process. There has recently been developed a most ingenious "block" for use as a tower packing which provides an absorption surface far in excess of ordinary packing. This block is a hollow-hexagonal prism, through the center of which runs a spiral passage. The block was designed primarily for acid absorption and is made of high-grade clay which produces an acid-proof block.

Ingenious as is the block itself, it is equalled by the machine which extrudes this complicated form in a continuous strip, all ready to be cut to length and fired. The "hexahelix" block is being manufactured by Maurice A. Knight of Akron, Ohio.

Catalyzing the Poison That Would Poison the Catalyst

REFERENCE has been made often, in these columns, to the chemical phenomenon of catalysis. The chemist explains it by saying that the substance called the catalyst speeds up the reaction between two substances, without itself being affected. To the layman, however (who probably knows almost as much about it after all) it appears that this stuff called the catalyst is a sort of magic wand which

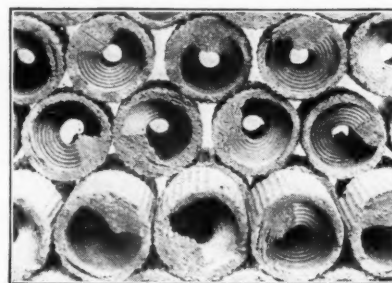
somehow transforms one or more gases into a totally different substance by simple contact.

Unfortunately, there are too often foreign substances present which spoil the whole trick by casting a spell over the magic wand or, as the prosaic chemist would say, by poisoning the catalyst. Thus the newer catalytic processes such as the synthesis of ammonia, synthesis of menthanol from water gas, and synthesis of petroleum from water gas, require the complete removal of sulfur compounds from the gases used. Even traces of organic sulfur compounds, which would be entirely unimportant when the gas is used as a fuel, are sufficient to destroy the catalysts used in these processes. Hydrogen sulfide may be satisfactorily removed on an industrial scale by well-known methods.

The only satisfactory process for removal of organic sulfur to the required extent, which has been used on an industrial scale, in this country at least, involves liquefaction of the gas at low temperatures. It is desirable, however, to have a cheaper method. Consequently, the Pittsburgh Experiment Station of the United States Bureau of Mines is starting an investigation of this problem. It has been claimed by Franz Fischer of Germany that organic sulfur compounds may be completely converted to hydrogen sulfide at relatively low temperatures when the gas is passed over appropriate catalysts at relatively low temperatures and in the presence of hydrogen.

Copper Traces in Tap Water Not Poisonous

THE question as to whether or not the amounts of copper found in our food and drinking water have any ill effects on the human organs, causing chronic diseases, is of importance because of the widespread use of copper and its alloys in the commercial manufacture of foods. Early



These hollow acid-proof clay "blocks" have a spiral passage which provides increased surface for absorption of gas by a liquid

investigators have not been uniform in their opinions, but the weight of evidence was that copper was not a harmful substance in the amounts ordinarily to be found in food and in drinking water.

Several years ago Dr. Mallory, eminent pathologist of the Boston City Hospital, announced that copper might be the underlying cause of cirrhosis of the liver, termed hemochromatosis. This conclusion was based upon a sudden increase in the number of autopsies showing the pathologic lesion. Practically all were of individuals who had been drinking post-war alcoholic beverages. Samples of bootleg liquors sold in Boston contained copper in larger amounts than

(Please turn to page 467)

... and so to bed ... late ... too much supper ... wish

I could get to sleep ... bad dreams ... business worries ...

dog barks ... baby cries ... time to get up ... jangled nerves

... irritable skin.

—then is the time your skin
needs the comfort of a fresh Gillette Blade



THE NEW FIFTY-BOX

Fifty fresh double-edged Gillette Blades (10 Packets of fives) in a colorful chest that will serve you afterward as a sturdy button box, cigarette box or jewel case ... Ideal as a gift, too. Five dollars at your dealer's.

THERE are mornings when a fresh Gillette Blade is better than any pick-me-up you can name.

And there are mornings when your beard is as tough and blue as your

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Miscellaneous

OPERATING COST STATISTICS OF AUTOMOBILES AND TRUCKS, Bulletin No. 91, presents to the owner or operator of motor vehicles valuable statistics regarding operating expenses. The data were compiled from a study of cost records on approximately 800 automobiles and 900 trucks, most of the information being supplied by state highway departments, fleet operators, and individuals operating their own cars or trucks. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE RURAL JUNIOR HIGH SCHOOL, Bulletin No. 28, of the Bureau of Education, is a study of the problems and experiments associated with the extension of the junior high school to rural communities. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

ATLAS OF COMMERCIAL WOODS OF THE UNITED STATES, by Dr. H. P. Brown, is featured by 60 plates illustrating the structure of various commercial timbers. "There is no mystery about wood identification," according to Dr. Brown. "Anyone can readily learn to recognize our common timbers if he will but train his powers of observation." *Extension Department, New York State College of Forestry, Syracuse, N. Y.—Two dollars (bound or loose-leaf).*

PRESENT HOME FINANCING METHODS is a 23-page paper published by the Bureau of Standards, outlining the facilities available to borrowers in financing the purchase of homes. *Superintendent of Documents, United States Government Printing Office, Washington, D. C.—Five cents.*

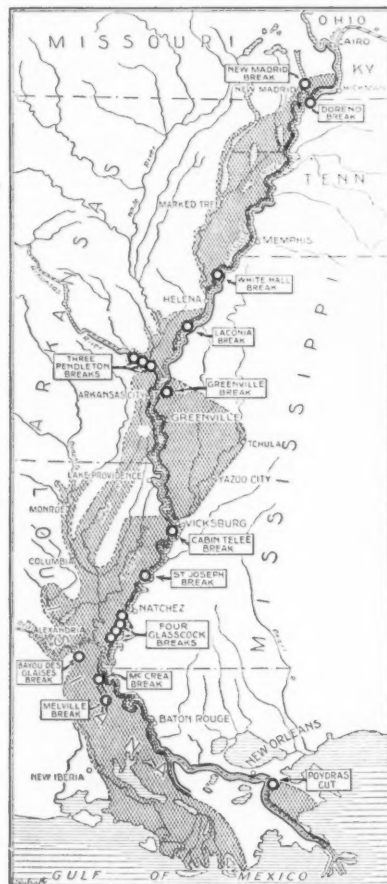
RELATION OF ILLUMINATION TO OCULAR EFFICIENCY AND OCULAR FATIGUE, Public Health Bulletin No. 181, gives the results of a study made in the main post office in Chicago from 1924 to 1926, to test the effect of different degrees of illumination on clerks. The increased efficiency and decreased ocular fatigue when illumination is increased is of considerable significance. *Surgeon General, U. S. Public Health Service, Washington, D. C.—Gratis.*

PUBLIC AQUARIUM, ITS CONSTRUCTION, EQUIPMENT, AND MANAGEMENT, Document No. 1045, is an interesting explanation of the various modes of constructing aquariums and the most successful methods of management. *U. S. Government Printing Office, Washington, D. C.—25 cents.*

PRACTICAL ASPECTS OF RESUSCITATION is a well illustrated booklet describing the causes and treatment for asphyxiation, with practical guidance as to the use of the

Schaefer method and the H-H Carbogen Inhalator in cases of emergency where natural respiration has stopped and can be restored by artificial respiration. *Mine Safety Appliances Company, Pittsburgh, Pa.—Gratis.*

PLAN OR PERISH and WASTE FROM MISSISSIPPI MUD, by J. Russell Smith, are reprints of two thought-provoking articles, one of which was awarded the Harmon prize as the best magazine article of the year. Dr. Smith, who is Professor of Economic Geography at Columbia University,



Courtesy New York Times

The 18,000 miles flooded last year when levees failed to do their duty

firmly and clearly states his opinion that the problem of the Mississippi floods can best be solved by the plan that has kept Egypt rich for thousands of years. *The John C. Winston Company, Winston Building, Philadelphia, Pa.—Gratis.*

WATER POWER RESOURCES OF CANADA is a well prepared annual review of the de-

veloped and undeveloped water power of the various Canadian provinces. Statistics are given showing the use of water power in the pulp, paper, and other industries, with a comparison of the coal equivalent. *Director, Dominion Water Power and Reclamation Service, Ottawa, Canada.—Gratis.*

Aeronautics

SOUNDPROOFING OF AIRPLANE CABINS is the first report of an investigation which is being carried out by the Bureau of Standards for the Aeronautics Branch of the Department of Commerce. The paper indicates that construction of the cabin walls in layers is the most practical way to obtain a reasonable degree of quiet without excessive weight, taking all factors of the problem of noise reduction into consideration. *Bureau of Standards, Department of Commerce, Washington, D. C.—Gratis.*

BIBLIOGRAPHY OF AERONAUTICS FOR 1927 covers the aeronautical literature published during the year, both in the United States and in foreign countries. The material is listed in dictionary form with author and subject entry, with sufficient cross reference for research in special lines. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

Agriculture

WORLD SURVEY OF THE LIVE-STOCK INDUSTRY, a pamphlet summarizing the results of a survey undertaken by the Bureau of Animal Industry, covers the activities of 33 countries with respect to live-stock improvement and outlines the principal methods in use, together with results obtained. *Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

ARTIFICIAL RIPENING OF FRUITS AND VEGETABLES is a 35-page bulletin with numerous illustrations and several color plates, discussing the ways of artificially ripening many kinds of fruit and vegetables. The bulletin includes a good bibliography on the subject. *Agricultural Experiment Station, University of Minnesota, St. Paul, Minn.—Gratis.*

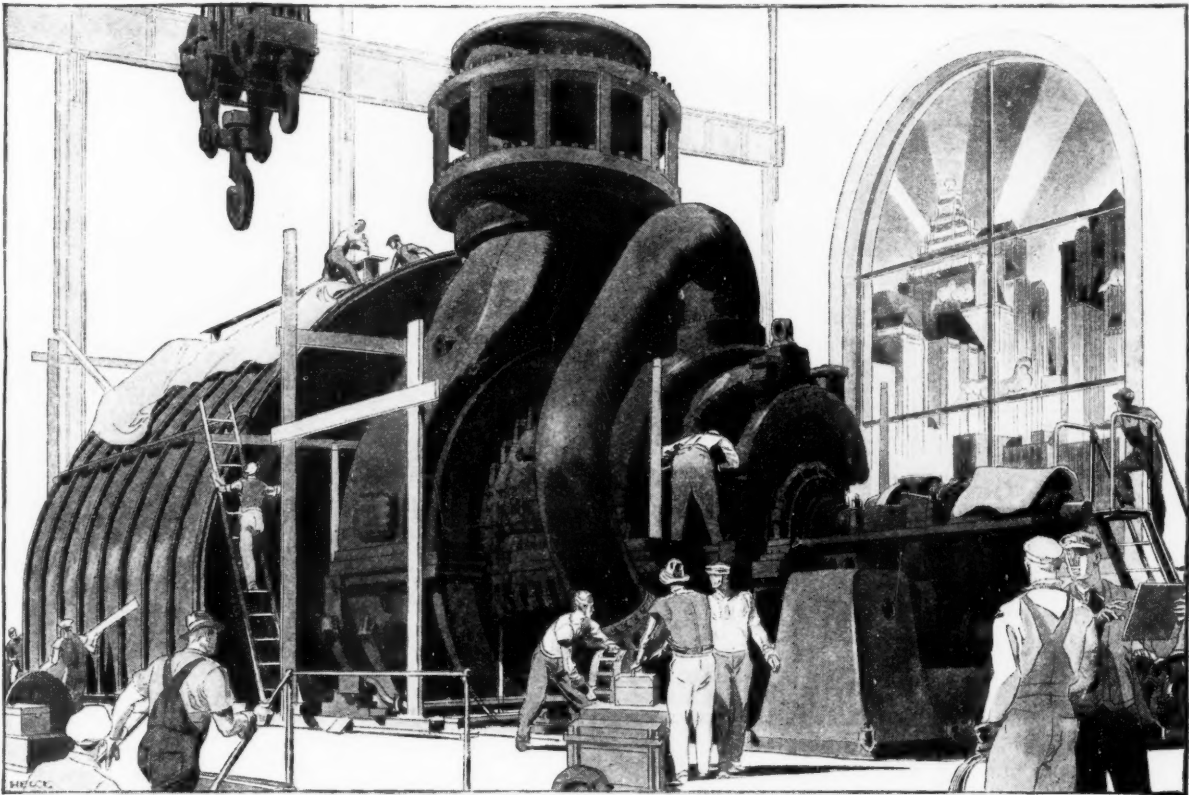
GROWING RYE IN THE WESTERN HALF OF THE UNITED STATES is a recent farmers' bulletin published by the Department of Agriculture. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

Coal

FALLS OF ROOF IN BITUMINOUS COAL MINES: INFLUENCE OF SEASONS AND RATE (Please turn to page 472)

SPEEDING THE WORLD'S WORK

DRAWN FOR WESTINGHOUSE BY C. PETER HELCK



THE WORLD'S LARGEST STEAM TURBINE-GENERATOR—BUILT BY WESTINGHOUSE. INSTALLED AT HELL GATE STATION, NEW YORK CITY, FOR THE UNITED ELECTRIC LIGHT & POWER COMPANY—EDISON-UNITED SYSTEM.

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Ten years ago it was not uncommon for electric light and power companies to develop only one kilowatt-hour of electrical energy for every four pounds of coal burned beneath their boilers. Today, Westinghouse turbines and other power-producing equipment help public utility management to treble its output of energy per pound of coal.

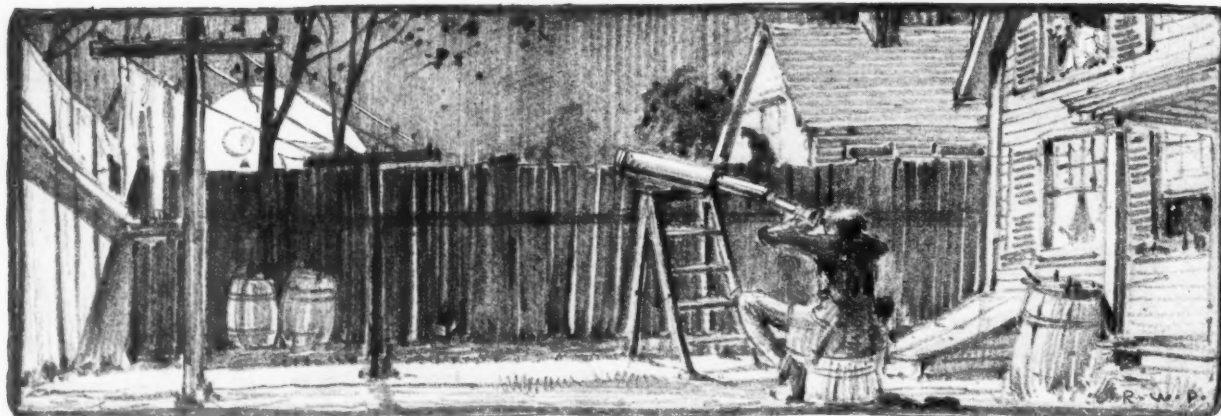
Here you have one reason why the average price of electricity today is lower than before the war, although the prices of most other things are higher.

Contributions of Westinghouse to more effective power production range from the largest turbines to the smallest, not merely for electric light and power companies but also for industry, mines and ships. They include auxiliary equipment for turbine installations, from stokers to every class of generating and distributing equipment. Westinghouse apparatus also includes the lighting units and motors which make electricity serve the everyday needs of home and industry. From the source of electrical power to its ultimate application in serving modern needs Westinghouse responsibility runs the entire course.



The Sign of a
Westinghouse Dealer

Westinghouse



The Back Yard Astronomer

HOW to make a neat, serviceable, light weight observatory without spending too much hard earned cash is a problem which has vexed many amateurs. Mr. R. W. Steber of the F. A. Steber Company, cigar manufacturers, Warren, Pa., has solved this problem. Incidentally he has made a 16 $\frac{5}{8}$ -inch telescope—one of the largest telescopes thus far made by means of the instructions in the book "Amateur Telescope Making." The entire space in this month's issue will be devoted to Mr. Steber's description, contained in a letter he was requested to write.

"The observatory," he states, "is 16 feet in diameter. Its side walls are 48 inches high. For a foundation we put down four six by six-inch chestnut posts, below the frost line. Next the post for the telescope was put in. This is a six-inch, steel well casing, set about six feet into concrete, and off center enough to allow for the overhang of the polar axis. The floor of the observatory was then built up on two-by-sixes, with the flooring laid diagonally for rigidity. Clearance was allowed around the post, to obviate vibration.

"On a 16-foot circle two-by-fours were placed at two foot intervals. These were braced plumb, and on them on the inside, was put a two-inch angle iron with the leg down. Through this a lag screw was driven into each post, making the whole very rigid. All angles throughout the whole job were rolled on an eight-foot radius. This simplifies things a great deal.

"We then sided the structure with regular six-inch weather boarding, which

had the lower inside edge rabbited out so that the siding would fit the strip beneath, and prevent the ends from pulling up when laid on a circle. This is one theory which distinguished itself by coming up to expectations.

"For the lower track we used a two-inch angle iron with leg turned up on the outside, screwed to the top of the uprights and screws countersunk to give a smooth track. The upper track is a one and one half inch angle iron, with a three quarter inch angle spot-welded to its under, inner edge, to make a race for the balls.

"Steel balls apparently are very expensive, even if 'seconds' are used, so we had the balls turned out of maple and then soaked them in linseed oil for a few days. All were heavily coated with grease and then put into place. Between the balls are sticks of wood about two feet long, cut as segments of a 16-foot circle, to act as spacers.

"For the dome, we made the opening of one and one half inch angle iron, with a flat top. The lower end is bolted into the upper track. The material used was just light enough so that we could punch out the holes with a large hand punch. After the frame of the opening was in place we bolted in the ribs, which are three quarter inch angle iron, leg side down. The upper or flat side of the angle was then punched in three or four places and slats of wood screwed on it. To these slats the canvas covering was tacked.

"In putting on the canvas, we started at the opening, which has a lateral brace at the bottom, and stretched the canvas over the adjoining rib, holding the rib in place by putting a couple of sticks between it and the opening; and so on, around, until we reached the other side of the opening. The wooden braces were then knocked out and the dome held its shape. This makes a remarkably rigid dome, and not too heavy for one person to handle. The canvas was painted at once with about 50 pounds of white lead and four gallons of linseed oil. On the first painting the canvas takes up all the oil it will hold. This makes it a perfectly watertight, neat, light dome.

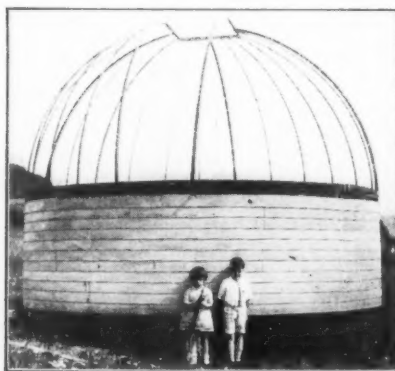
"Along the sides of the irons forming the opening, we bolted on a wooden coaming about three inches high, and then made a strip of canvas four inches wider than the opening, sewing a flexible wire into the

sides of the canvas, and a heavy roller across the bottom. There is also an occasional light wooden strip tacked across its width, to act as a spreader and to help bear the weight of snow and ice in the winter. Then, with a rigging very similar to what is used on a roller awning, we roll up the canvas out of the way at the top of the dome; and when finished, roll it down very quickly, stretching it tight so that the sides of the canvas come down over the coaming, making it storm proof.

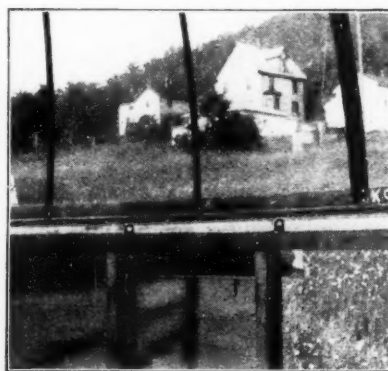
"The telescope itself has a 16 $\frac{5}{8}$ -inch mirror of 125 $\frac{1}{2}$ inches focal length. The tube is of 16-gage steel, allowing a three quarter inch air space along the sides. The cell is of the conventional type. The finder is a two and five eighth inch doublet, 16-inch e.f.l., with cross hairs in the field.

"For the axes, Ford axles were used. The housing at the brake end was machined off, and a 194-tooth gear bolted into this, and against the gear rests a slip plate which acts as a clutch. Through this plate run three heavy adjusting studs over springs for regulating the pressure of the plate on the gear, and thus the amount of drag or slip between the ring and the axle. In this way, we swing easily to any position, and at once pick it up in slow motion. As the tube and fittings weigh several hundred pounds it is necessary to have this very accurately fitted for use with high powers.

"The declination axis has a rod running from the gear to an easy position at the eyepiece. The declination lock is another rod, parallel to the first, running through the brake-band housing and screwing



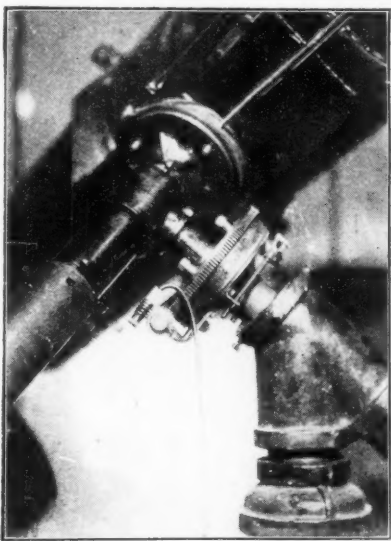
The observatory ready for roofing



Wooden ball-bearings and spacers

against the part which was formerly covered by the brake lining.

"The polar axis has the same gear and plate movement, but the drive goes through another 12-to-1 worm and gear, giving a reduction of about 4000-to-1. This makes the drive very steady and powerful. This gear is driven through a speedometer cable, on the end of which is a handle similar to a file handle, with the cable run through it lengthwise and having a small crank. With this arrangement, the drive can be used by the observer; or, once the tube is set in declination, the object may be held in the field by some one other than the observer, who makes a turn of the handle once in 23 seconds. Next to having a driving clock, this is very satisfactory when one's friends wish to look, as the



The worm-drive mounting

only necessary admonition is to keep hands off the telescope.

"The eyepiece is the regular rack and pinion type. We use negative oculars down to one fourth inch. This size gives a magnification of 500 diameters with this mirror. We are having 750x and 1000x made, but 500x is as high as we can generally use, and then only on very good nights.

"We expect to build a clock drive, although the flexible cable idea is highly satisfactory—in some ways perhaps preferable. The whole machine is surprisingly satisfactory, and for a first attempt, much better than we had expected."

Just as this issue goes to press we receive a letter from Mr. Steber, which reads as follows: "The telescope was built by H. A. Thurn and myself, Mr. Thurn being the mechanical genius and I supplying the ideas, most of which did not work. The telescope is most satisfactory and is arousing considerable local interest in astronomy."

Perhaps the statement we made in the April issue, that the cost of the spectro-heliograph was comparable to that of a fine radio set, was a bit optimistic. If the outfit is purchased, complete, it will cost about as much as a low-priced motor car. We have, however, seen too many examples of the ability of the ingenious amateur to get around high costs by doing most of a job himself, to do much worrying about this point. Those who plan to make spec-



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troheliostopes are requested to keep in touch with telescope editor, who quite naturally takes an interest in the work of other amateurs.

Don't miss the article on another page, describing Hamilton's large reflector. We have on hand several descriptions of rather unusual jobs, and these will be published in due course. It is thought that many other jobs have not been reported for publication. Don't hide your light under a bushel, fellow amateurs.

Amateurs who definitely plan to make Cassegrainians will receive information to their advantage on communicating with A. G. I., Tel. Ed.

The Heavens in May

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: May 7.
At 10 1/2 o'clock: May 15.
At 10 o'clock: May 22.

At 9 1/2 o'clock: May 30.

At 9 o'clock: June 7.
At 8 1/2 o'clock: June 14.
At 8 o'clock: June 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

MERCURY is an evening star and should be easily seen about the time of his greatest elongation, which comes on the 15th, as he is far north and does not set till 9 P.M.

Venus has passed into the morning sky and is conspicuous there, especially toward the end of the month, when she rises before 3 A.M. With the telescope she appears as a crescent, growing broader but smaller in diameter as time passes.

Mars is an evening star in Cancer, but remains in sight till nearly midnight. He is more than 150,000,000 miles away by this time and is but a little brighter than a second magnitude star.

Jupiter is in conjunction with the sun on the 14th and is invisible this month.

Saturn is in the opposite quarter of the heavens and rises between 9 and 10 P.M. Uranus is a morning star, rising about 3 A.M., while Neptune, which is in quadrature on the 20th, is visible in the evening.

The moon is in her last quarter at 8 P.M. on the 1st; new at 1 A.M. on the 9th; in her first quarter at 4 P.M. on the 15th, full at 8 A.M. on the 23rd, and in her last quarter for the second time at 11 A.M. on the 31st. She is nearest the earth on the 11th and

farthest away from the earth on the 26th.

At this new moon, there is an eclipse of the sun which, since she is near perigee, is total and of a long duration—five minutes at maximum. The shadow track starts in the Indian Ocean, south of Madagascar, and sweeps far across the sea before it comes to land in northern Sumatra and the Malay Peninsula. After another long traverse of the China Sea it passes over the central part of the Philippines, to lose itself in the expanses of the Pacific. This is an important eclipse, although weather conditions are unfortunately none too favorable, and several parties are on their way to the countries which we have named.

There is still a great deal to do in the way of eclipse observation, especially upon the spectra of the solar atmosphere and the corona, and we may hope for much of interest if the sky favors.

The remaining events of the month are unimportant—conjunctions of the moon with Uranus on the 6th, Venus on the 7th, Jupiter on the 9th, Mercury on the 10th, Mars on the 14th, Neptune on the 15th, and Saturn on the 25th. Jupiter is four degrees east of the sun at the time of the eclipse and should add to the spectacle.

Industries from Atoms

(Continued from page 460)

had been suspected and it was felt that it had been dissolved from the copper coils during distilling of the crude liquors.

This finding was so contrary to the general consensus of investigators that the Departments of Industrial Hygiene and Pathology of Columbia University jointly reopened the whole question of the effects of copper on the human system. Extensive experiments have convinced the scientists that the quantities of copper that are found in food and drinking water will not injure any human organ. In fact the evidence accumulating shows that small amounts have a beneficial effect on the blood in cases of anemia.

Chromium Plate Adds to Its Conquest

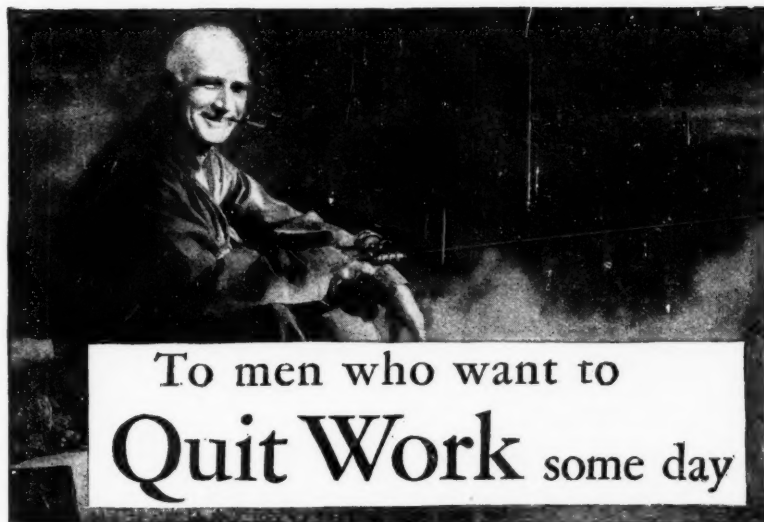
CHROMIUM plating, having taken by storm the radiator shells, bumpers, and other "bright parts" of our automobiles, now creeps behind the head-light lens and spreads itself over the reflector. The fact that it does not dull as quickly as nickel plate is sufficient justification for its triumph, but refined scientific investigation has revealed the additional information that a chromium plated surface possesses unique light-reflecting properties. Two scientists of the United States Bureau of Standards, W. W. Coblenz and R. Stair, have conducted a most interesting study of the reflecting power of nickel, silver, chromium, beryllium and several other metals, revealing the inherent peculiarities of each in reflecting light waves of various lengths.

The results of this work, reported in the *Bureau of Standards Journal of Research* disclose the ability of various polished metal surfaces to reflect light waves, not only in the range of the visible spectrum, but on both the infra-red and the ultra-violet sides. Data are presented on the ultra-violet reflecting power of various metals—beryllium, chromium, cobalt, nickel, silver, speculum, stellite, and stainless steel. For chromium and beryllium the observations extend into the infra-red.

The observations show that contrary to the general experience with other metals, beryllium has a high reflectivity at 250 millimicrons in the ultra-violet, followed by an appreciably lower reflectivity with a minimum at about 400 millimicrons in the visible spectrum.

Chromium has a higher reflectivity than nickel in the ultra-violet and is, therefore, the more efficient as a reflector of ultra-violet radiation. The reflectivity of chromium is conspicuous for its relatively high maximum (70 percent) at 425 millimicrons followed by a wide flat minimum which extends from about 600 millimicrons in the orange to wavelengths beyond 2000 millimicrons in the infra-red.

Another interesting fact disclosed by this study is that the "dulling" or disintegration of metal mirrors is accelerated by ultra-violet light. To test the resistance of chromium plate to such action, a chromium mirror was exposed at a distance of 15 centimeters, for 30 hours to the total radiation from a 110-volt Cooper-Hewitt quartz mercury-arc lamp. The effect of ultra-violet radiation in decreasing the reflecting power of chromium is most marked for wavelengths less than 300 millimicrons, the decrease at 254 millimicrons being from



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64 to 59 percent. For wavelengths greater than 300 millimicrons, the reflecting power curve of this sample after exposure was about 1 percent lower than that of the unexposed sample, and practically coincident with the reflectivity curve of the unexposed sample. From this it appears that ultra-violet radiation has but little effect upon the disintegration and consequent lowering of the ultra-violet reflecting power of chromium.

Study Effects of Perspiration on Dyes

"YES, miss, this color is guaranteed fast unless you wear it when you are all tired out." By a stretch of fancy one can imagine the clerk thus warning the purchaser of a brightly dyed gown, if current investigation reveals the expected data on the effect of perspiration on the permanence of aniline colors. Fatigue, certain diseases, and some unusual occupations are believed so to change the chemical composition of perspiration as to react differently on dyed fabrics.

Dr. S. G. Barker, director of research at Torridon, Headingley, Leeds, the headquarters of the British Research Association for the Woolen and Worsted Industries, states that no definite knowledge of the chemical constitution of perspiration is available; neither is there any knowledge regarding the action of the atmosphere on perspiration after it has been exuded from the body. Further, it is unknown whether a normal person exudes alkaline or acid perspiration, many cases of both types having been found.

People of a tubercular type, those engaged in mines or in specific occupations exude perspiration which is quite different in character from that of other persons. Investigations are being made of normal and abnormal perspiration produced under a variety of conditions, such as after excessive manual labor, fatigue, during athletic performances, or in artificially reproduced atmospheres, such as would be produced in various baths. It is planned to extend the tests to people suffering from a variety of complaints, such as rheumatism, et cetera, where perspiration has a very definite meaning. As a result of this work, it is hoped that it will be possible to place the manufacturer in a position to give a test to his fabrics, so that the hosiery trade particularly will know the precise effect of perspiration not only on the dye stuff, but on the fabric itself.

Prevents Peanut Butter from Sticking in Mouth

EVEN those fond of peanut-butter must admit that it displays a pernicious habit of sticking to the teeth, gumming up the entire masticating equipment and making one feel like a dog which has just started to chew on a caramel. This tendency of an otherwise admirable delicacy is due to the fact that the paste produced by grinding the nuts is dry.

Donald W. Howe, of Biloxi, Mississippi, has just come forward with a boon to myriad molar by inventing a way to eliminate the stickiness of peanut butter by incorporating in it a powdered material ground fine, presenting a large surface area upon which saliva may act. A large variety of substances may be used for this purpose, such as powdered fruit juices; dextrins; proteins; sodium, potassium, and ammonium salts of acids, such as the chlorides,

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sulfates, tartrates, citrates, lactates, and acetates. The higher the solubility of the incorporated powder, the greater its effect in reducing the clogging effect in the mouth.

New Aluminum Solder

A NEW aluminum solder known as "Soldalume" has been announced by the Aluminum Solder Corporation of America, 730 Fifth Avenue, New York, N. Y. The solder consists of a white powder which is melted at a temperature of 350 to 400 degrees, Fahrenheit, by heat applied to the metal at a point adjacent to the joint to be made. It is said that a temperature of 800 degrees, Fahrenheit, is required to destroy the joint. Tests are reported to have shown a tensile strength of 12,000 pounds per square inch for aluminum-to-aluminum butt joints, and 30,000 pounds for duralumin butt joints.

New Products Enter Baking Powder and Plastic Fields

ADIPIC acid, known as adipic acid in Germany, and its derivatives, have recently become products of more general importance, says the Berlin correspondent of *Chemical and Metallurgical Engineering*. The Duetschen Hydrierwerke, which have specialized in the hydrogenation of benzol, naphthalene, and homologs, have developed a new process, presumably through the oxidation of one of these products, which now makes these substances available at comparatively low prices. Since extended experiments have shown that the physiological action of adipic acid is harmless, it can be used for many purposes for which tartaric acid has formerly been used; this suggests its use in the baking powder industry, for beverages, for medicinal purposes, et cetera, and the more forcibly since its price is lower than that of tartaric acid.

In the baking powder industry, adipic acid is superior to tartaric acid only to a slight extent, 100 grams liberating 60.27 kilograms of carbon dioxide as compared with 58.66 from tartaric acid. Its difficult solubility in cold water is a disadvantage. In lemonade manufacture, the use of water-soluble homologs is preferable, for example, B-methyl adipic acid, which may be derived from methylcyclohexanol or even from cresols. In the latter case it is associated with acetylvaleric acid, but this type of mixture can find application in the textile, leather, and other industries.

Of comparatively great importance, however, are the esters of adipic acid. Foremost among these are the neutral esters of cyclic alcohols, which can be used as gelatinizing agents in all industries, such as the celluloid, artificial leather, lacquer, film, nitro-cellulose, or cellulose industries, which have hitherto resorted to camphor and expensive substitutes for camphor.

The methylcyclohexylester (Sitalan) dissolves not only cellulose esters but also rubber. It is used in the manufacture of leather-oils and varnishes, because of its softening effect which remains, even at low temperatures, a property of value in the manufacture of belts.

Sitalan can be used as an adhesive for celluloid and similar materials. The product obtained through the esterification of adipic acid and glycerine is at first a plastic mass but hardens subsequently to a point where it might be used as a substitute for resin, rubber, et cetera.



Planning high-speed business

*An Advertisement of the
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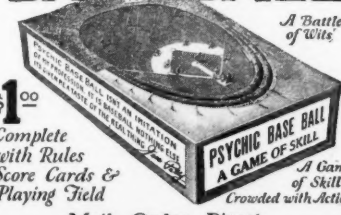
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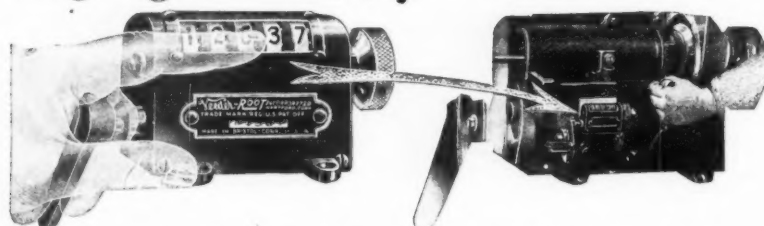
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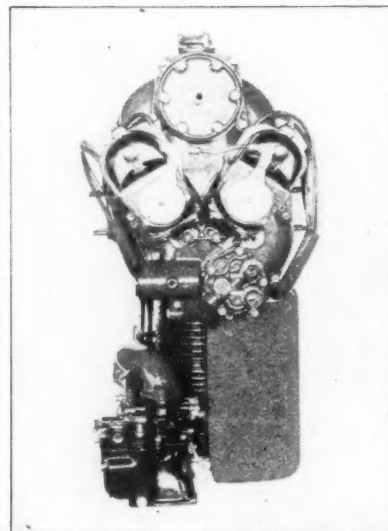
(Continued from page 456)

airport. It is only at the end of 200 hours of flying that he can obtain a transport license, and consider that he has put his foot on the first rungs of the ladder.

A Small Inverted Engine

WHAT are the tendencies in small air-cooled engines for light planes? They are likely to be of the cylinder-in-line type, because head resistance for this type is smaller than that of the radial type, the vision of the pilot is less obstructed, and an in-line engine resembles an ordinary automobile engine more closely than the radial engine, and so is easier for the average mechanic to handle. Another tendency is to have the engine inverted. An inverted engine impedes the pilot's vision even less than the ordinary in-line engine, and it is a trifle easier to work on an inverted engine than on the normal engine. Still another tendency is to seek ruggedness rather than extreme light weight.

All these tendencies are exemplified in the Rover engine built by the Michigan Screw Company. The Rover has four inverted cylinders in line, and weighs 210 pounds for its 55 to 60 horsepower, which in airplane practice is fairly heavy. The cubic displacement is 236 cubic inches,



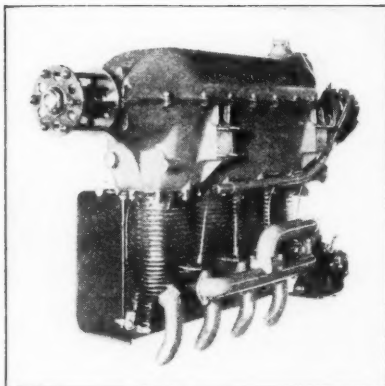
End view of Rover engine

which again shows no attempt at crowding power. As in all airplane engines, aluminum and duralumin are used freely. All the accessories are mounted at the back, so that the nose of the plane may be as clean as possible. Our two photographs indicate the neat and robust character of the Rover. Engines of this type should encourage the construction of light planes.

Preparing An Airline

THE United States is rapidly being covered with a net work of airlines, and thousands of men are engaged in this new industry. J. G. Ray, in a paper before the American Society of Mechanical Engineers, outlines the hard and careful work which has to be done before a line is put into operation.

In the original selection of a line, the



Rover engine. See opposite page

determining factor is the volume of possible business, and a very careful survey has to be made. The next step is to get in touch with the cities along the route, and their Chambers of Commerce. Local people have to be stirred to enthusiasm in the matter of airports and landing fields, and at the same time to be so guided that they will not make mistakes in building such facilities. A desirable preliminary step is to fly over the route with a camera, making pictures every five or ten miles.

In the selection of equipment, the results of the business survey must be taken into account and there must be no undue optimism. If the work is carrying mail, and the estimated average load is 200 pounds, a 500-pound capacity plane is large enough to start with, and buying a plane with 1000-pound carrying capacity is extravagance.

Mr. Ray states that an airline will need a pilot for approximately every hundred miles where a single schedule is maintained. If the schedule can be so arranged that every pilot can have his own ship, so much the better. Every airplane "feels" different, and every set of instruments functions in slightly different fashion. Therefore a pilot will do much better with a plane to which he has become accustomed.

An airline should be divided into operating divisions which are between 300 and 500 miles long. Two divisions can be grouped under one superintendent who is stationed at the connecting terminal. Inspection and maintenance work should be concentrated at this station. At other division points, particularly if only small planes are employed, the personnel comprises only a field manager and a mechanical crew. At the intermediate stops very little fixed equipment is needed.

Servicing of the planes should not be necessary at these intermediate stops. It is at the ends of the division that a hangar is necessary, with a certain amount of office space, and space for mechanical shops.

At the operating base, larger shops are needed. A parachute loft should be provided, as well as an instrument room completely equipped to test all instruments. The overhaul shop should be very complete, and ought to include a stand for testing motors after overhaul. The navigating instruments, particularly the bank and turn indicator, the air speed indicator, and the compass, must be kept in perfect condition.

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Current Bulletin Briefs

(Continued from page 462)

OF PRODUCTION, by J. W. Paul of the United States Bureau of Mines, is a study of the influence of changes of temperature and moisture on the roofs of coal mines. This study, designated as Technical Paper No. 410, has 40 pages and 25 charts. U. S. Government Printing Office, Washington, D. C.—10 cents.

THE CLASSIFICATION OF NORTH AMERICAN COALS, Information Circular 6094, is a report of the progress being made to correlate and combine the various coal classification systems into a standard system applicable to all North American coals. U. S. Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.

Engineering

GEOLOGY OF RESERVOIR AND DAM SITES, with a report on the Owyhee Irrigation Project in Oregon, presents valuable information regarding the geology, construction, and attendant problems of dam sites, dams, and spillways, of various major projects. U. S. Government Printing Office, Washington, D. C.—30 cents.

THE PLACE OF THE COMPLETE CORROSION SURVEY IN INDUSTRY is a reprint from a recent article in the Gas Age-Record describing the Richards method of conducting sub-soil corrosion surveys, for long-distance pipeline projects and city distribution systems where metal buried underground is subject to corrosion. Ford, Bacon, and Davis, Inc., Engineers, 39 Broadway, New York, N. Y.—Gratis.

Industry

HIGH TEMPERATURE INSULATION presents information regarding materials used for boiler and furnace insulation, with considerable data relating to temperature gradients and heat loss per square foot per hour through insulated and uninsulated walls. Celite Products Company, Los Angeles, California.—Gratis.

ELECTRIC HEAT IN GENERAL ELECTRIC FACTORIES describes typical installations for electric heat in several different manufacturing processes, particularly in the treatment and manufacture of glass products. General Electric Company, Schenectady, New York.—Gratis.

COMPETITORS WHO HAVE CO-OPERATED TO IMPROVE QUALITY presents facts and figures showing the outcome of several interesting experiments in co-operation. The booklet is well illustrated. Electric Steel Founders' Research Group, Chicago.—Gratis.

TRADE STANDARDS ADOPTED BY THE COMPRESSED AIR SOCIETY AND STANDARDS OF THE HYDRAULIC SOCIETY present valuable and practical information, particularly from the standpoint of the manufacturers, in these two branches of industry. The former is a 47-page booklet describing standards for air compressors, piping, and

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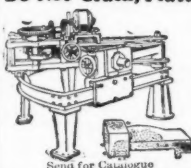
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FOREIGN TRADE OF THE UNITED STATES IN THE FISCAL YEAR 1927-1928, by Lawrence B. Mann and Grace A. Witherow, discusses briefly the distribution of trade, the commodities handled, and the values involved. *United States Government Printing Office, Washington, D. C.—10 cents.*

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INVENTIONS and PATENTS

Their Development and Promotion

By MILTON WRIGHT

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Lumber Exporters Urged to Use Brand

ONE of the principal assets of an exporter of lumber or lumber products is an established brand, according to a recent statement of the United States Department of Commerce. The exporter is urged to take this step for his own protection, according to the Department, because unmarked lumber often sells at a lower price than marked lumber of the same quality.

"An established brand or shipping mark is one of the principal assets of a lumber exporter. Too much consideration cannot be given the importance of establishing a brand in the foreign lumber markets," the statement says. "The importer or agent realizes that the exporter with an established brand has a certain reputation to live up to, and that this reputation has been built up through constant effort, and has developed a standard for quality and manufacture that is recognized in the foreign markets."

It is further pointed out that American exporters should give careful consideration to the advisability of registering brands or shipping marks in the foreign countries in which they are developing business. The laws covering registration of trademarks (brands or shipping marks) vary in most foreign countries, and in many countries ownership of a brand can be established only by registration. In such countries, if the mark of an American shipper is registered by another, the American shipper is precluded from the use of the mark except through or with permission of the party holding the registration.

In this same connection, it is interesting to note that the branding or grade marking of soft-wood lumber is now being taken up on a nation-wide scale in the United States, as a means of establishing confidence on the part of the ultimate consumer.

The matter of registering trademarks in foreign countries, or for use in the United States, should be taken up with a reputable firm of patent and trademark attorneys equipped to care for foreign registrations. The best of these firms maintain departments for handling foreign business of this sort, and are always glad to furnish general or specific information upon request.

Inventors and Engineers Lauded

SO much has been said recently in praise of engineers that it is interesting to note some credit being given to inventors, who so frequently work hand-in-hand with engineers. Dr. Glenn Frank, president of the University of Wisconsin, presents an English translation of a certain German book in which due tribute is paid to inventors as well as engineers. The following quotation from the book is significant:

"The true champions of the masses are our engineers and inventors. The inventor of the automobile has benefited horses more, has saved them from more toil and suffering, than all the world's societies for the prevention of cruelty to animals. We have no galley slaves because they have

been emancipated by the inventor of the marine engine. The use of fuel oil has redeemed an army of stokers from the inferno of the stokehole. The ultimate end of technical progress is to provide every man with the comforts and conveniences that are today reserved for millionaires. Therefore the inventors and the engineers are fighting want and poverty, they are not fighting wealth; they are fighting slavery, they are not fighting rulers; their object is to universalize wealth, power, leisure, beauty, happiness. The ideal of the engineers and the inventors is not to make all mankind a proletariat, but to make all mankind an aristocracy."

What Do You Mean—Rayon?

IT is not difficult to ascertain, by test, whether a fabric is cotton or flax, wool or silk. Each material has a certain composition and formula, and responds to certain tests in a characteristic way. But try to test several samples of "rayon." The analysis will show that rayon may be one thing in one shop, and something quite different in a shop across the street. In the rapid development of the artificial silk industry there have appeared eleven manufacturing firms producing fibers that are known as rayon, although not all have the same formula, and not all have the same constituents. Naturally the properties and characteristics of the various products are somewhat different.

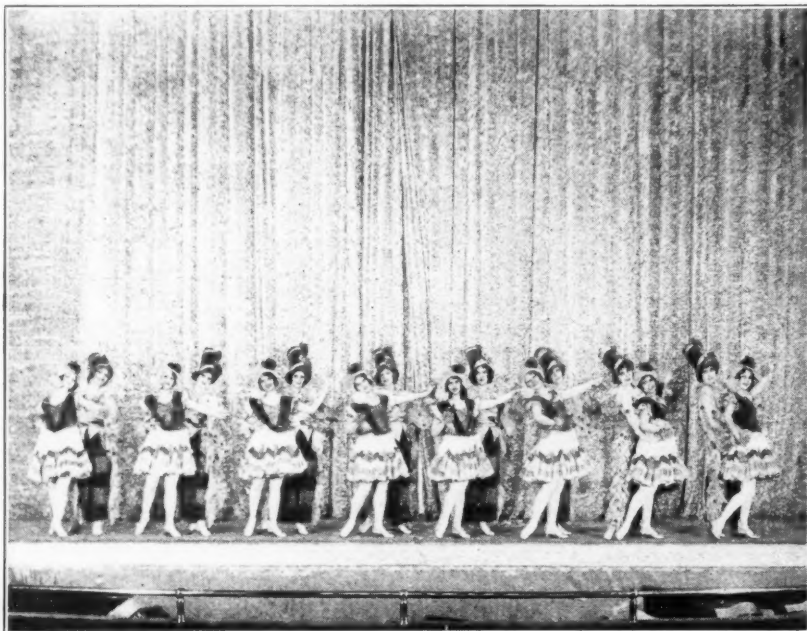
But regardless of the difference, the Better Business Bureau, backed up by the Federal Trade Commission, has designated

"rayon" as a general term, with the same significance as the words "cotton," "silk," or "wool." All artificial silk is officially known as rayon. This action was taken to safeguard those who might confuse real silk with man-made imitations.

As it has been pointed out by *The American Silk Journal*, in a recent issue, we have viscose and acetate, cupra-ammonium and nitro-cellulose "rayons," and they all respond differently to tests. The resulting confusion troubles wholesale and retail buyers even more than it does the public.

Among the manufacturers who protest against having their products classified as "rayon" is the Celanese Company. Many a silk-worm has gnashed its teeth when somebody mentioned Celanese, for that is the product that has displaced natural silk as the draperies and alleged garments that more or less cover the "glorified American girl" in most of the current Broadway stage attractions. It is the contention of the Celanese company that its product responds to tests in an entirely different manner than common rayon; it dissolves in acetone; it leaves, when burned, a crisp ash-like material, but without smell; it shows distinctive chemical qualities; and it dry cleans by the usual methods, although precautions must be taken against liquids that contain chloroform, ether, or acetone.

"There is no doubt that there is a growing interest in rayon," according to *The American Silk Journal*. "Silk always will be silk, and it will always have its intrinsic value because it has three times the tensile



Artificial silk is now being used for draperies, curtains, and costumes, in some of the elaborate musical comedies on Broadway. This scene, showing one of the luxurious Celanese curtains, is from Earl Carroll's production, "Fioretta"

strength of rayon. But the lustrous beauty of some of its substitutes has given them a firm place in the industrial world, and particularly in the manufacture of things beautiful. This year we will use about 115,000,000 pounds of rayon, and 50,000,000 pounds of silk, according to the most accurate data obtainable from the rayon producers and the Silk Association of America."

In materials that have artificial silk in a mixed weave to bring out the details of a pattern, it doesn't matter very much what its chemical reaction may be. But when one sees a product designated as all "rayon" or "Celanese," or whatever it may be called, one is naturally interested in the composition of the material.

Regarding Trademark Renewals

UNLESS the request for renewal of a trademark is made "at any time not more than six months prior to the expiration of the period for which the certificates of registration were issued or renewed," the petition for renewal will be denied.

This was decided by Commissioner Robertson, in ruling that the Regal Shoe Company, of Boston, could not file an application for a renewal of the registration of a trademark, in view of the fact that the 20-year period had expired. Obviously the purpose of the renewal is to keep the registration in force, the Commissioner declared, otherwise the office would be granting a new certificate of registration.

Trade Commission Decisions

LIKE a vigilant watch dog, defending the property of those to whom it belongs against all who might seek to steal it or acquire it without due right, the Federal Trade Commission appraises the merits of all comers in any controversy over trademark rights and other commercial property. In most cases decided by the Federal Trade Commission, the consuming public is the primary beneficiary. Several recent examples of these decisions may be cited to show the policy of the Commission.

"English Broadcloth" and "Imported English Broadcloth" cannot be used as a label for shirts or other garments unless the goods bearing the label were made in England. Hyman Finkelstein, a New York dealer in shirts, bought a cotton fabric termed "broadcloth" by its American manufacturer. But by the time the cloth had been manufactured into shirts, it had become "English Broadcloth," according to Finkelstein's labels. It was ruled that this practice was calculated to deceive not only the retail dealers with whom he did business, but also a substantial portion of the purchasing public, into the belief that the shirts so labeled were made of material imported from England. The word "broadcloth" is not, in England, applied to any cotton fabric.

Seeking to capitalize on the popularity of union-made goods of certain types used largely by members of various trade unions, a manufacturer of overalls labelled his product "Union Made" although his employees were not members of any union. The manufacturer has signed an agreement with the Federal Trade Commission whereby he promises to refrain from this objectionable practice.

In cases of this kind, the names of indi-

viduals or firms signing stipulation agreements are not mentioned by the Commission in its announcements to the public. The facts are presented, however, to show methods of competition condemned by the Commission as unfair, for the guidance of industry and protection of the public.

A large corporation engaged in the manufacture of powders and concentrates for use in the preparation of beverages and soft drinks has promised to cease representing that its products are produced from apples, raspberries, grapes, oranges, and other fruits. This company also manufactures soaps, and has agreed to cease representing its products as "Pure Olive Oil Castile Soap" when in truth the soaps are not manufactured from olive oil. Certain "Lemon Complexion Soap" and "Lemon Soap" produced by the same company will hereafter be known by a different name, or be *bona fide* lemon products.

"The University of Applied Science," operated by T. J. Cook of Chicago, must cease representing to its prospective pupils that the price of a course of instruction offered is a special or reduced price, when such is not the fact. Mr. Cook was guilty of a number of practices on which the Federal Trade Commission frowned. He was ordered to desist from representing that any article of merchandise or service is furnished free to pupils, when the price of such is included in the regular price of the course; from representing that he

furnished to the prospective pupil a life membership in an "identification bureau;" and from representing that his business is a "University of Applied Science." He was also told to discontinue the practice of alleging that he is the president of a "university."

Novel Combination of Old Practices

IN a patent infringement suit involving mechanical excavators and ditchers, it has been held that pull-stroke machines are different from the ordinary steam shovel in that they dig inwardly, as a hoe or a pick, rather than away from the machine, as a shovel. In the case of Keystone Driller Company *versus* the Byers Machine Company, et al, in the district court for the Northern District of Ohio, it was pointed out that the plaintiff's patent device accomplished; old results in a new and useful manner, as well as new and better results, by reason of a novel combination of some old elements.

The judges found that the patents of the plaintiff were infringed by the defendant's constructions. The Keystone Driller Company had developed the art to a new point, and, in the opinion of the judges, the defendant had constructed its "Byers Bear Cat" machine as a result of studying the plaintiff's conceptions, and copying the mechanism and construction of machines patented by the Keystone Driller Company.

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT—Having a special form of shock absorber which is particularly adapted to relieve the craft of undue shock when effecting a vertical landing, or when the craft is landing in an emergency. Patent 1701407. Rogelio Garcia, 134 W. 103d St., New York, N. Y.

Pertaining to Apparel

SEASHORE OUTFIT—For street wear, or on the beach as a dressing gown, and so arranged that a bathing suit may be put on or taken off while wearing the garment. Patent 1696714. Nathan Heller, 1575 East 8th St., Brooklyn, N. Y.

COMBINED SUPPORTER AND UNDERGARMENT—For women, equipped with means for drawing inwardly and downwardly on the diaphragm, to give the figure a graceful appearance without injury to the vital organs. Patent 1701425. Rose B. Scognamiglio, c/o Mrs. Rose Binner, 561 5th Ave., New York, N. Y.

SEPARABLE FASTENER—A flexible linking means of the separable button-type for the normal fastening of cuffs, or a loose spaced fastening such as is desirable in warm weather. Patent 1701461. Palmer L. Graham, 806 Ohio St., Terre Haute, Ind.

COMBINATION GARMENT AND CARRIER BAG—Particularly adapted for a raincoat, in which the bag may conveniently serve for a hood when the garment is worn, and a container when the garment is transported. Patent 1702143. David Weisz, 750 Caldwell Ave., Bronx, N. Y.

HAT—Of the so-called sport type for ladies, formed of a plurality of plaited strands, having strength and durability to hold its shape, yet may be folded for packing. Patent 1701130. Gerald H. Simon, 989 Market St., San Francisco, Calif.

Designs

DESIGN FOR A SHOE—Patent 77345. Herman Wilhelm, c/o Bernard Barnbaum, 1440 Broadway, New York, N. Y.

DESIGN FOR AN EMBLEM OR THE LIKE—Patent 77648. Carl K. MacFadden, 17 Battery Place, New York, N. Y.

DESIGN FOR A STOCKING—Patent 77715. Clarence B. Smith, c/o Leo Frankel, 244 Peachtree Arcade, Atlanta, Ga.

Electrical Devices

CIRCUIT CLOSER—Adapted to sound an alarm when a jewel or money box with which the circuit is associated, is lifted bodily from its support, or when its lid is raised. Patent 1696713. John T. Harrigan, 425 Walnut St., Elizabeth, N. J.

RESISTANCE—Which is very sensitive and accurate and may be readily adjusted to vary the action, may be used with current rectifying devices, telephone stabilizing or other electrical uses. Patent 1701386. George J. Mucher, 4 Park Place, Troy, N. Y.

SELECTOR AND AUTOMATIC TONER FOR RADIOCIRCUITS—Which makes use of a novel selector for tuning a receiving circuit with the incoming wave; the tuning element being con-

trolled by the surge of plate current at resonance, the tuning may be operated by a distant control. The inventors have been granted two patents, 1700281 and 1700282. Elmer E. Burns, and Theodore Cohen, 3515 Home Ave., Berwyn, Ill.

SEPARABLE ELECTRICAL CONNECTION—Which embodies a lamp bulb and associated socket, so constructed that the bulb may be inserted into the socket by direct thrust as opposed to a turning movement. Patent 1702135. Thomas C. Sawers and Harry J. Blair, 1502 Ave "H," Brooklyn, N. Y.

ELECTROMAGNET - CONTROLLING MEANS—For circuits including electromagnets, especially where the electromagnets are employed for releasing spring latches, which is comparatively simple in construction and operation and economical to install. Patent 1703077. Harry D. Wethling, 318 Main St., Orange, N. J.

Of Interest to Farmers

SHOCK LOADER AND CONVEYER—A machine for piercing a succession of shocks, subsequently elevating the same to a position whereby they are out of contact with the ground, and then transporting the loaded shocks. Patent 1702141. Luther T. Velen, Cheswold, Del.

IGNITING DEVICE FOR SMUDGE POTS—Which is extremely sensitive, and rendered active by a thermo-responsive means, thus positively insuring ignition at a predetermined low temperature which would be injurious to a citrus fruit grove. Patent 1701133. Joseph A. Ulmer, 2501 E. 52d St., Huntington Park, Los Angeles, Calif.

RIDGING MACHINE—Particularly adapted for blocking off land for irrigating purposes, is capable of adjustment for different kinds of soil, such as black adobe, or sandy loam, and requires relatively small horsepower. Patent 1700117. William S. Booth, Rout 1, Box 280, Mountain View, Calif.

MILKING MACHINE—To be applied to milch animals for holding a teat and for squeezing the milk therefrom without causing a back-flow or other injury to the animal's health. Patent 1702468. Edward A. Englund, Route 5, Box 87, Hillsboro, Oregon.

Of General Interest

COMBINED HOLDER AND CASE—A portable means for carrying the cards, sheets, or a ledger in bookkeeping systems, from one place to another, the contents being readily removable, or closed under lock and key. Patent 1702996. LaRue R. Coppage, c/o Coppage Printing and Loose Leaf Co., 47 Warren St., New York, N. Y.

LINCURSTA AND METHOD OF MAKING THE SAME—Whereby a two-tone effect is produced by a colored backing sheet with a plastic composition thereon, which is subjected to a die roller for embossing the design thereon. Patent 1702161. Milton K. Huppuch, c/o The Decorative Co., Hudson Falls, N. Y.

CARD HOLDER—Which enables the easy and quick interchange of cards and provides a secure mounting for them when in use, particularly adapted for use in connection with advertising apparatus. Patent 1700786. Emanuel Dobrowsky, 168 W. 96th St., New York, N. Y.

COMBINED IRONING BOARD, CONVERTIBLE TABLE AND CABINET—In which the door, table and ironing board are supported in such manner that they are free to be swung outwardly from the cabinet, and adjusted to working position. Patent 1700545. Clyde W. Sanders, 1915 Yosemite Drive, Eagle Rock, Calif.

SEALING OF BOTTLES—Wherein both inside and outside of the neck are threaded, a soft stopper being screwed into the neck, while a cone of hard material, in the screw cap, forces the soft stopper into an air-tight fit. Patent 1702182. Joannes M. B. Van Vlijmen, c/o Nederlandsch Octrooi-Bureau, 31 Laan Capes Van Cattenburch, S. Geavenhage, Holland.

SAFETY RAZOR—Wherein a double edge blade may be used, but only one edge in operation at a time, the guard being swingable to permit the honing of the blade. Patent 1701462. Charles M. Hickey, 30 W. 59th St., New York, N. Y.

WEATHER STRIP—Especially adapted for application to a door frame, a flexible element which will be engaged by the opposed edge's surface of the door, and will retain its flexing condition. Patent 1702217. Augustus Miller, 70 Greenwood Ave., East Orange, N. J.

AWNING—Having adjustable parts to cause the awning to function as a sun shield or a combined sun and rain shield, yet permitting a free circulation of air. Patent 1700555. Karl N. Watkins and Stiles O. Clements, 1128 West 7th St., Kis Angeles, Cal.

DOLL CONSTRUCTION—Wherein the appendages may have rotatory movement and the legs, arms and head may be connected in a novel manner, without the use of springs or wires. Patent 1702208. John Glow and Hyman E. Chiet, c/o Allied Grand Doll, 66-68 Greenpoint Ave., Brooklyn, N. Y.

PACKAGE CONTAINER—Formed of light metal, for the reception of a package of cigarettes, and constructed in such manner that partial ejection can be effected, and individual removal facilitated. Patent 1700539. Allston C. Ladd, c/o Union Printers Home, Colorado Springs, Colo.

CIGARETTE-PACKAGE HOLDER—Which includes a skeleton framework with a hinged cover, serving to prevent crushing of the package and its contents, while permitting the ready withdrawal of the cigarettes. Patent 1702187. John Wolfe, 20 Rue de la Paix, Paris, France.

NAIL CLIPPER—Which is compact and durable with no protruding corners or sharp edges, the operating lever acting as a locking member when the parts are in closed position. Patent 1702137. Max Schnefel, 684 So. 17th St., Newark, N. J.

PORTABLE CRIB—Which when extended will support an infant in reclining position, includes a flexible body which may be readily detached for laundering, and may be easily collapsed for transportation. Patent 1702015. Louise A. Mand, 122 North Mariposa St., Los Angeles, Calif.

TOOTHBRUSH HOLDER—Adapted to house the bristles of a brush, and keep them in an atmosphere impregnated with an antiseptic, for preventing germs or bacteria from propagating. Patent 1696706. Walter C. Athon, "Personal" Cody, Wyo.

MASK—Which may be decorated or undecorated, and when cut from a single blank, may be folded to produce a more or less projecting nose, forehead, eyebrows, and a supporting handle. Patent 1703034. Thayer Grimes, c/o Chas. Frank, Room 2160 Graybar Bldg., 420 Lexington Ave., New York, N. Y.

PORTABLE LIGHTER—Which is designed to be carried in the pocket of the user and operated by one hand to light a cigar or cigarette, a spring-pressed latch controls the ignition. Patent 1703033. David W. Greene, c/o M. E. Bernhardt Co., 230 Fifth Ave., New York, N. Y.

MAGAZINE PENCIL—Adapted to contain a supply of leads of standard diameter, which are successively fed to a projected writing position without breakage, jamming, or clogging. Patent 1703038. William K. Holmes, 409 Pearl St., New York, N. Y.

WINDOW-FRAME CONSTRUCTION—Including a sill and side casing cut to provide rabbeted joints which excluded the elements of weather, such as air and water, and prevents the consequent rotting of the frame. Patent 1703021. Charles G. Voigt, 121 W. Marie St., Hicksville, L. I., N. Y.

INSECT TRAP—In which the mature female mosquito may readily lay her eggs, but which will prevent the escape of the larvae after the eggs have hatched, thus preventing their propagation. Patent 1703022. William Weinrich, Box 2713, Honolulu, Territory of Hawaii.

TRAY—Designed to constitute a container unit to be emplaced on shelves in stores for holding articles of merchandise, the articles being always dressed to the front of the shelf. Patent 1702987. Gordon C. Wilson, Glendo, Wyoming.

INDEX BOOK—Having a plurality of cards disposed to take up a minimum of space, each card being hinged so that in either turned-up or closed position the tabs are readable. Patent 1702357. Carl A. Meilicke, 5423 Winthrop Ave., Chicago, Ill.

CONNECTING MEANS FOR STRAPS—Capable of being instantly connected to and secured against disconnection from, a wrist watch or other article, without rendering the straps bulky or uncomfortable to the wearer. Patent 1702855. Arthur W. Swanson, c/o Cordova Leather Shop, 643 So. Olive St., Los Angeles, Calif.

Hardware and Tools

COMBINATION TOOL—Which is a combination of an adjustable miter square, a perpendicular and a horizontal level bubble, a rule and a sliding marker, adjustable on a scale. Patent 1695662. Edgar G. Morin, Jr., 4004 20th St., San Francisco, Calif.

SPIRIT LEVEL—So constructed that a broken bubble tube can be readily replaced, and the mode of adjustment being such that ordinary jars will not render the level inaccurate. Patent 1703006. Ralph H. Jay, 1230 Ferry St., Eugene, Oregon.

ALCOHOL INJECTOR—Whereby alcohol or analogous fluid may be forced or directed into a gas pipe to clear the same when the gas in the pipe is frozen. Patent 1702972. Louis J. C. Larsen, 506 W. 49th St., New York, N. Y.

SCOOP—Which will not only serve for scooping ice cream or other edible products, but will be positive in its action to eject the formed quantities for confections or other purposes. Patent 1703023. George C. White, 382 Chapman St., Irvington, N. J.

DOOR LOCK—In which the lock housing and the latch are extensible for use on different standards of doors, and whereby an outer knob may be locked from the inside against operation. Patent 1701790. Edgar G. Morin, Jr., 4004 20th St., San Francisco, Calif.

WRENCH—Having a fixed jaw, and a detachable section, which may be readily replaced when worn, is adjustable, and particularly adapted for gripping pipes or circular objects of various diameters. Patent 1702148. Roy J. Breseman, 125 Harrison St., Waupaca, Wis.

Heating and Lighting

HEATING DEVICE—In the form of a gas heater, and a spark plug for igniting the gas, means being arranged to automatically open the switch after ignition has been attained. Patent 1700559. Louis F. Clausing, c/o Royal Metal Works, 3588 20th St., San Francisco, Calif.

Machines and Mechanical Devices

MECHANISM FOR USE WITH ARTICULATED MOLD FORMS—For concrete, the sectional frame having a plurality of aligned tie elements held by a locking tie rod, and means to grip and releasably hold said rod. Patent 1696699. Harold R. Suiter, c/o Concrete Form Co., 326 Mt. Vernon Ave., N. W. Grand Rapids, Mich.

COIN-CONTROLLED VENDING MACHINE—Wherein the parts are so constructed as to prevent the use of spurious coins, and which automatically locks itself when the last article has been vended. Patent 1702154. Dwight T. Clark, 11 Lincoln St., East Orange, N. J.

FLUID-PRESSURE PUMP—Having a pair of balanced valves forming inlet and discharge valves, for a fluid under pressure and adapted to force liquid from the well through a separate-discharge pipe. Patent 1701449. Forrest E. Gilmore, 728 Wright Bldg., Tulsa, Okla.

FILM SIGNALING DEVICE FOR CAMERAS—For preventing double exposure or non-exposure of a film, the device may be applied to conventional cameras, with but slight structure modification. Patent 1696533. Fred W. Gage and Albert W. Tondreau, 1519 Cambria St., Los Angeles, Calif.

HAT-RENOVATING MACHINE—Having simple and effecting means for steaming the brim of the hat, for altering the shape of the brim, and for pressing both sides of the brim. Patent 1695646. Louis Flicker, 1415½ Fifth Ave., Los Angeles, Calif.

APPARATUS FOR HANDLING WELL CASINGS—Through the medium of the conventional rotary drill pipe, the invention being characterized by the substitution for the hydraulic means of a mechanical means for engaging the casing. Patent 1696526. Carl R. Crossen, Route 1, Box 254, Los Gatos, Calif.

DISHWASHING MACHINE—Comprising a washing compartment, a motor driven propeller, for circulating water in said compartment, the weight of a dishpan being enough to start the motor in operation. Patent 1699042. James L. Bell and Hermann Euwecke, 2211 Market St., Oakland, Calif.

DEVICE FOR DRYING, STEAMING, AND CONDITIONING TUBULAR FABRIC—A device including a duplex coil, over which tubular fabrics may be drawn for removing excess moisture, and then "conditioned," or steamed to give the desired finish. Patent 1696682. Maurice M. Kasanof, 3190 Rochambeau Ave., Bronx, N. Y.

BRICKMAKING MACHINE—A mold for forming hollow concrete blocks having one surface faced to simulate bricks presenting an odd number on one row and an even number on another row. Patent 1701438. Fred T. Baum and Clarence G. Norris, c/o B. & N. Brick Tile Mfg. Co., Marion, Ind.

MULTIPLE FACE AND POINTER CONSTRUCTION FOR GAUGING INSTRUMENTS AND WEIGHING MACHINES—Which is not unduly complicated and may be read from practically any direction in which it is viewed, thus materially increasing its efficiency. Patent 1701412. Henry J. Lawrenz, 1823 Church Ave., Brooklyn, N. Y.

BOAT-PROPELLING MEANS—Comprising an upstanding frame, and means for manually driving the propeller at a relatively high speed, the frame being foldable to inactive position below the gunwales of the boat. Patent 1701381. Mattia Marangoni, 308 East 25th St., New York, N. Y.

APPARATUS FOR MAKING PRETZEL-STICK DOUGH BLANKS—In which the dough is conducted over a tortuous path and changed from the lump form from the mixer, to a succession of rods and in condition for baking. Patent 1701850. George W. Holtzman, c/o Pretz-Stick Baking Co., Myerstown, Pa.

FABRIC OR CLOTH UNWINDING OR UNROLLING MACHINE—For supporting a bolt or roll of fabric to permit any desired length being taken therefrom or placed thereon, without the fabric being folded by hand. Patent 1702971. Wootton W. Jefferess, Box 1204, Dallas, Texas.

SOAP-PASTE DISPENSER—Which includes a manually operable discharge mechanism which will exert a pressure for dispensing varying quantities of the soap, constituting an economical, convenient, and sanitary medium. Patent 1703032. Horace P. Gorman, 86 Grandview Ave., Rye, N. Y.

MACHINE BAR—An element terminating in a ball and socket member, whereby it may accommodate itself to any required position, for employment as a mining column for supporting rock drills. Patent 1701122. LeRoy E. Ridgeway, 3115 E. 4th St., Long Beach, Calif.

CABLE CONNECTION—Whereby drilling apparatus of the rotary type may be withdrawn from a well in the event of a breakage, either in the drill pipe, or the drill. Patent 1701812. George H. Koerner, 314 Moraga St., San Francisco, Calif.

COIN-CONTROLLED RADIO RECEPTION APPARATUS—A time measuring mechanism for radio broadcasting, whereby after the deposit of a predetermined coin, the radio-reception circuits are automatically closed a predetermined length of time. Patent 1702411. William N. Olsem, 1678 Sacramento St., San Francisco, Calif.

Medical Devices

RUBBER NOZZLE FOR CHEMICAL AND LIKE PURPOSES—Adapted to fit over the neck of a bottle or the like, and allow the liquid to continuously and uniformly flow therefrom when the bottle is inverted, without creating bubbles. Patent 1701421. Ernesto G. Ponti, c/o G. Capuccio, Via Arsenale N. 17 Turin, Italy.

Prime Movers and Their Accessories

CURRENT-CONDUCTING APPARATUS—For internal combustion engines, wherein the distributor and conductors to the spark plugs are insulated by a solid conduit, to prevent short circuits, thereby producing a maximum current. Patent 1692087. Francis H. Matthew, Martin A. Broadbent and Frederick C. B. Vosgerav, Box 15, Walnut, Calif.

ENGINE—Having a peculiar mode of connection between the pistons and the power shafts, whereby owing to the elimination of many parts, power and smoothness of operation are increased. Patent 1701439. Charles G. Canfield, Yale, Okla.

Railways and Their Accessories

GRADE CROSSING—A device which provides positive means for slowing up vehicle traffic adjacent to railroad tracks, may be applied to any crossing without altering the road construction. Patent 1699886. Roy H. Gerard, 817 Phelan Bldg., San Francisco, Cal.

AUTOMATIC CROSSING BLOCK FOR RAILWAYS—An electric system which causes gates to be closed and a signal bell rung as the train enters a block, and releases the gates when the train leaves the block. Patent 1702150. Taylor M. Cain, Box 383, Ogden, Utah.

Pertaining to Recreation

SPORTING GUN, RIFLE AND THE LIKE—A double barrel gun of the under-and-over type, provided with locking bolts and an inertia weight slidably mounted to automatically effect the cocking of the second trigger on the firing of the gun. Patent 1702153. Arnold L. Chevallier and Robert Churchill, c/o E. J. Churchill, Gunmakers, 39 Leicester Sq., London, E.C., England.

AMUSEMENT APPARATUS—In which power driven passenger carrying conveyances are caused to move eccentrically, and are given sudden jerks in various directions, in order to provide unexpected thrills and excitement. Patent 1702136. Thomas Sawers and William E. Evans, Jr., 1502 Ave "H," Brooklyn, N. Y.

Pertaining to Vehicles

TIRE SHOE—Especially designed to be quickly attached to an automobile tire and adjusted to positively grip the tire, regardless of its size, without marring the felly. Patent 1695450. F. H. Bryant, Box 591, Mill Valley, Cal.

BRAKE - RELEASING DEVICE—For automatically releasing the hand or emergency brake of an automobile, the releasing operation being accomplished by the depression of the clutch pedal. Patent 1696702. William H. Watlington, Colorado Life Co., Patterson Bldg., Denver, Colo.

AUTOMATIC EXHAUST VALVE—Adapted for a practically instantaneous exhaust of an air actuated machine operated through remote control irrespective of the speed of operation of the control valve. Patent 1697353. Ervie A. Ferris, Box 3, Westwood, Calif.

LICENSE-PLATE HOLDER—Adapted to be removably secured to some fixed part of an automobile, for positively retaining a license plate in spring pressed arms, against displacement or loss, yet readily removable. Patent 1701419. Joseph B. Peden, Temperance, Mich.

DEMOUNTABLE RIM AND TIRE LOCK—So constructed as to render it applicable to all types of wheels and demountable rims, and will prevent an unauthorized person from removing the rim and tire from a wheel. Patent 1702139. Rogers W. H. Thomas, Newark Road, Zanesville, Ohio.

AUTOMOBILE SPRING—A semi-elliptical spring adapted to be interposed between the body and the axle, so constructed that as one end is compressed, the other will be expanded, and the body kept steady. Patent 1702030. Charles E. C. Edey, 2592 West Pico St., Los Angeles, Calif.

OIL AND AIR FILTER AND LUBRICATOR—Particularly adapted for automobiles, wherein the lubricating oil is filtered, the air cleaned and caused to convey some of the oil to the interior of cylinders and inlet valves. Patent 1702156. William C. DeWitt, P.O. Box 150, Newburgh, N. Y.

RESILIENT SUPPORT FOR CUSHION SEATS—Which includes a frame and a plurality of independently mounted cushion supports which closely conform to the localized weight and are not canted by two persons of extremely different weights. Patent 1701831. Albert Weickman and Chaney Olmsted, c/o C. S. Olmsted, 218 E. 59th St., New York, N. Y.

TROUBLE-LIGHT OUTFIT—Constructed and arranged to be "built into" an automobile, housed out of the way, yet always available for use, the cable being supported on a spring tension reel. Patent 1698643. William J. Mattson, Box 731, North Hibbing, Minnesota.

FENDER VISE—For holding automobile fenders, to facilitate repairing, the arms are adjustable independently, and the mount universally adjustable, whereby the fender may be supported in any position. Patent 1697117. John R. Hilsted and Harry H. Canterbury, c/o Geo. G. Griffith, 124 East Lemon Ave., Monrovia, Calif.

GEAR SHIFT—A clutch pedal having resilient means for causing the gears to be shifted without chance of stripping, the device may be readily applied to standard transmission mechanism. Patent 1698199. Arthur C. Nickell, Jr., 364 Broadway, Waukesha, Wis.

GUIDE FOR AUTOMOBILE JACKS—By means of which a jack may be guided to jacking position beneath the axle without the operator having to go under the automobile. Patent 1699406. John E. Ravlin, Route 5, Miami, Fla.

SIGNAL DEVICE FOR PNEUMATIC TIRES—For indicating to the driver of a vehicle, that low pressure exists, in sufficient time for him to reinflate the tire and prevent serious injury thereto. Patent 1699366. Joseph H. Loeb, Morgan City, La.

SHIELDING DEVICE FOR VEHICLES—For Shielding the occupants of a closed car against the elements from a window opening, or against the direct sun rays, yet will not obstruct the view. Patent 1698871. Stephen M. Beatty, 3810 W. 58 Place, Los Angeles, Calif.

WAGON CONSTRUCTION—In which the reach head of each reach bar is so designed as to not only afford maximum strength, but also the utmost freedom of movement. Patent 1698642. Francis A. MacNab, c/o Knight Ranch, Granby, Colo.

LUBRICATING SYSTEM FOR AUTOMOBILES—A centralized system which includes an automatically filled reservoir having a plunger therein which when manually operated will supply lubricant to the various parts of the chassis. Patent 1703039. Henry L. Hubbard, 13823 Fernwood St., E. Cleveland, Ohio.



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